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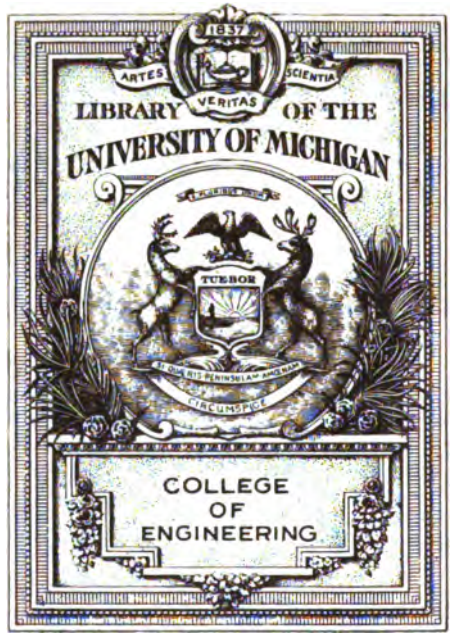
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WHARF MANAGEMENT
STEVEDORING AND STORAGE

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WHARF MANAGEMENT
STEVEDORING AND STORAGE

BY

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TO

THE HON. JOSHUA W. ALEXANDER

sometime Secretary of Commerce of the United States and Chairman of the Committee on Merchant Marine and Fisheries of the House of Representatives, in appreciation of his contribution to the upbuilding of American foreign trade, shipping, and safety at sea, and the friendship and courtesy shown to the authors while serving under him in the Department of Commerce and as his representatives to the conference for relief of congestion at the Port of Havana, Cuba,

THIS BOOK IS RESPECTFULLY DEDICATED

399057

EDITORS' PREFACE

THIS is the fifth volume of a series dealing with the business of ocean shipping and transportation. The first volume, *Ocean Steamship Traffic Management*, by Professor G. G. Huebner, bore the following Editors' Preface:

"This volume upon the management of ocean steamship traffic is the first of a series of manuals designed to assist young men in training for the shipping business. The necessity for such a series of manuals became evident when, as a result of the Great War, the tonnage of vessels under the American Flag was, within a brief period, increased many fold. To carry on the war, and to meet the demands of ocean commerce after the war, the United States Government, through the Shipping Board and private shipyards, brought into existence a large mercantile marine. If these ships are to continue in profitable operation under the American Flag, the people of the United States must be trained to operate them. Steamship companies, ship brokers, and freight forwarders must all be able to secure men necessary to carry on the commercial and shipping activities that make use of the ships. A successful merchant marine requires ships, men to man the ships, and business organization to give employment to the vessels.

"In its Bulletin upon 'Vocational Education for Foreign Trade and Shipping' (since republished as 'Training for Foreign Trade,' Miscellaneous Series No. 97, Bureau of Foreign and Domestic Commerce, for sale by the Superintendent of Documents), the Federal Board for Vocational Education includes among other courses suggested for foreign trade training two shipping courses upon subjects with which exporters should be familiar, namely, 'Principles of Ocean Transportation' and 'Ports and Terminals.' Although such general courses are helpful to the person engaging in the exporting business, a training for the steamship business as a profession requires much greater detail in the knowledge of concrete facts of a routine nature. An analysis was made of the various divisions of the steamship office organization and it was suggested to the United States Shipping Board that as no literature existed of sufficient

practicability and detail, several manuals covering the principal features of shore operations should be written.

"The response of the Shipping Board was hearty. The Board appointed Mr. Emory R. Johnson of its staff, then conducting an investigation of ocean rates and terminal charges, as editor. The Federal Board for Vocational Education designated Mr. R. S. MacElwee, then engaged in the preparation of studies in foreign commerce. Before the project was completed Mr. Johnson severed his connection with the Shipping Board in 1919, and in January, 1919, Mr. MacElwee became Assistant Director of the Bureau of Foreign and Domestic Commerce, Department of Commerce. The interest of the editors in the project did not terminate, however, and their close coöperation has been voluntarily continued out of conviction that the works will be helpful.

"The books have been written with a view to their being read by individual students conducting their studies without guidance, also with the expectation that they will be used as class text-books. Doubtless colleges, technical institutes, and high schools having courses in foreign trade, shipping business, and ocean transportation will desire to use these volumes as class texts in a manner outlined in the 'Training for the Steamship Business,' by R. S. MacElwee, Miscellaneous Series 98, Bureau of Foreign and Domestic Commerce, Superintendent of Documents, Washington, D. C. It is expected that evening classes and part-time schools organized under the patronage of the Federal Board of Vocational Education, Chambers of Commerce, and other interested organizations will find the manuals useful. Should these volumes accomplish the desired purpose of giving the American people a somewhat greater proficiency in the business of operating ships, they will have proved successful."

This volume upon *Wharf Management, Stevedoring, and Storage* is the first of its kind to be published. It deals comprehensively with the part of the shipping business that has not received adequate consideration in the past. The book shows that large economies can be brought about by the more expeditious and economical handling of freight at terminals and by the subsequent quicker turn-about of vessels. The book should be of value, not only to those having direct charge of wharf administration, stevedoring, and other terminal operations, but also to others who are desirous of knowing how the ocean commerce of the United States can be handled more economically.

THE EDITORS

AUTHORS' PREFACE

In presenting a volume upon *Wharf Management, Stevedoring, and Storage*, the authors realize that a subject so complicated can be treated only suggestively rather than exhaustively. So far as is known, this is the first effort to put between covers the vocation of loading and dispatching ships from the administrative standpoint. We, therefore, trust that this volume will take its place in the series upon ship management and operation and will blaze the trail to a closer and more scientific study of this problem. We are firmly convinced that the principal economies in ship operation and the successful competition of the American merchant marine on the high seas depend upon these terminal operations. Only through the systematic and painstaking study of all the elements involved in the efficient dispatch of vessels can these economies be accomplished. We trust that those who read these pages will gain interest in more efficient wharf management.

Roy S. MacElwee
Thomas Rothwell Taylor

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WHARF MANAGEMENT
STEVEDORING AND STORAGE

CHAPTER I

WHARF EFFICIENCY AND SHIPPING PROFITS[1]

Wharf Superintendent.—The main consideration of the wharf superintendent is to help make a profit for the steamship company to which he is responsible. The merchant marine of any country is the sum total of all those privately owned and operated ships that represent the capital investment of their owners and must be so operated as to earn a return on that investment. The company's freight agent may show great energy and considerable skill in securing cargo for the ship, but his abilities are checked by the prices fixed by supply and demand in the cargo-space market as reflected in the prices that we know as steamship rates. Of course, in abnormal times when demand far exceeds the supply, many companies may exist under various kinds of bad management and still make a profit; in such times it is not very difficult for the freight agent to fill his ship at high prices for the space, even with poor service and extravagant costs.

Problems of the Directors.—Likewise, the gentlemen around the green table who lay out the voyage of the ship, the ports at which they are to call, the services inaugurated, etc., must show rare judgment and knowledge of the world's commerce, and they prosper in accordance with their ability to judge the world's markets for steamship transportation. However, skillful as they may be, their abilities are limited largely by the condition of the world shipping—matters quite beyond their control. Fortunes were made

[1] By R. S. MacElwee and Thomas R. Taylor.

at the beginning of the World War not because of any particular ability on the part of those who made them, but because of the fortunate circumstance that they happened to have ships when ships were badly needed.

Good Management of Ship Essential.—Good management may be shown in the operation of the ship, as well as in its construction and design. The extent to which good management is shown is reflected in the company's success and profits. Efficient management ashore and afloat is essential to success in time of normal shipping conditions because of the peculiar intensity of international maritime competition.

Even if all forms of management afloat and ashore be good and efficient, in normal times of close competition and low freight rates the pier superintendent can make or break the steamship company by his ability or lack of ability to handle freight quickly and expeditiously over the wharves at the company's terminals and by the skill of his stevedores in stowing freight for the maximum yield for each voyage. There is no single point in the whole shipping business where efficiency of organization and management is so important in spelling loss or profit as at those points under the jurisdiction of the wharf superintendent. By a quick turn-around of the ship, shortening her days in port, by loading her to her maximum earning capacity, and by prevention of claims for damage or loss, the wharf superintendent can be the greatest single profit-maker of a steamship company.

Profit in a Quick Turn-around.—The earning power of a ship is measured largely by the percentage of idle days in port as compared with the active days steaming at sea. Recent statistics show that even under the pressure of war conditions many of the Shipping Board's fleet, and also many ships of private lines, spend more than half of the days in a year in port. One set of figures showed a relation of fifty-three days in port to forty-seven days at sea. When a ship is tied up for loading or discharging, or for repairs, or for other purposes, it represents simply a liability to the company owning her. She represents an asset only when she is carrying cargo from point to point. Freight rates are paid to have cargo transported—this is the service to be rendered. The ship is earning only when it is rendering this service. It is, therefore, important to attain quick discharge and loading of the ship at port in order to make her pay by carrying cargo.

Costs Per Day in Ship Operation.—The amount of the overhead costs in port are appalling to the layman not familiar with shipping. In fact, many of the deck and engine personnel of the new American merchant marine who received their training in the United States Navy or nautical schools have little knowledge of cargo matters in merchant shipping, and are lacking in appreciation of many matters, especially time. The overhead charges while in port of a large-sized cargo-carrier, at present-day ship values (1920), is from $2,000 to $4,000 per day.

To be explicit as to the daily cost of operation we may take figures of a few small vessels, representative of the average small or middle-sized tramp. These are operating costs for complete voyages (1919):

1. The *Mariners Harbor*, 3,535 dead-weight tons, had the following average daily operating costs for two voyages of 33 days each: First voyage, $855.34; second voyage, $678.40; average for the two voyages, $766.87 per day. To this may be added the overhead charges against depreciation and interest, $287.67 per day. This makes a total of $1,054.54 per day for the two complete voyages. Even yet, the loss of earning power while held in port is not included in these figures.

2. The *Mineola* averages for a voyage of 37 days $1,080.36 per day. To this must be added depreciation and interest, $333 per day, making a total of $1,413.36 per day for the voyage, excluding loss of earning power while in port.

3. The *Sacramento*, 7,462 dead-weight tons, made a trip from San Francisco to the west coast of South America and up to Wilmington, N. C. (1918). The average daily expenses were $1,169 and the depreciation and interest $614, making a total of $1,783 per day, excluding loss of earning power while in port.

4. The *Amacortes*, 7,478 dead-weight tons, made a trip from Seattle to the west coast of South America and back to Baltimore (September and October, 1918), with an average of $1,317.75 per day for operating costs, and $577.85 for depreciation and interest, totaling $1,895.60 per day for the voyage.

Interest and Depreciation.—Mr. Rossiter, for some time Director of Operations of the United States Shipping Board, in a hearing before the Ways and Means Committee in October, 1919, stated that the interest, insurance, and depreciation amounted to about 16 per cent of the value of the ship. Therefore, when a ship

is in port this one item alone amounts to a large sum, quite aside from the wages and subsistence of officers and crew, the fuel that is necessary to keep the ship warm in winter, to operate the winches, electric dynamos, and other machinery on board, and such charges as berthage, watching, etc. Considering, therefore, operating cost, insurance, depreciation, and interest on the investment, and then the loss in earning power for every day the ship is not moving goods from place to place, one will readily see that the amount of daily loss for a ship in port piles up.

Items of Expense in Ship Operations.—A list of items by which the expenses of operating a ship are calculated is given below; an actual case is given as an illustration.

DETAILS OF DIRECT OPERATING EXPENSE

Type of ship	Cargo
Size of ship	8,700 dead-weight tons
Speed of ship	10½ knots per hour
Fuel	Coal
Trade route	Between New York and West African coast
Total length of voyage	12,800 nautical miles
Voyages per year	3

Total tons cargo carried per year (full cargo in each direction):	
Outbound	20,136
Inbound	21,866
Total	42,002
Freight rates:	
Outbound	$25 per ton
Inbound	20 per ton
Total revenue from freight charges	$940,720
Direct operating expense:	
Fuel	$165,167
Loading and discharging	147,007
Repairs and maintenance	69,600
Wages	65,750
Port charges	39,148
Agency fees	23,518
Subsistence	23,269
Stores and supplies	11,200
Husbandry (management)	4,800
Total	$549,459

Insurance, depreciation, and interest are not considered to be direct operating expense.

Account	Cost per annum	Cost per diem
Interest at 5 per cent	$38,525.00	$105.55
Depreciation at 6 per cent	46,230.00	126.66
Reserve for maintenance and repairs per dead-weight ton per month	65,790.00	180.02
Insurance:		
Hull and machinery at 6 per cent	46,230.00	126.66
Marine at 3¾ per cent	28,893.75	79.16
War Risk at 5 per cent	38,525.00	105.55
Protective and indemnity	2,157.50	5.91
Seamen's		3.98
Total	$266,351.25	$733.49

Cost of Holding a Vessel in the Port of New York

The excessive cost of a vessel in port is given in detail by Mr. T. W. Cleworth, of the Port Facilities Commission of the United States Shipping Board.[2]

Port Movements.—The vessel arrived in New York from Genoa, Italy, in August, 1918, with 2,713 tons of wines, hats, cherries, marble, and general cargo, and sailed the same month with 3,783.1 tons of sugar, cocoa, canned goods, and Red Cross supplies for Archangel, Russia. The total time spent in port was 14 days, 17 hours, and 24 minutes.

Time Spent in Port by a Selected Steamer

	Hours	Minutes
At anchor, Brooklyn, off quarantine	19	14
At Brooklyn pier waiting commencement of discharge	17	15
Discharging and loading cargo at Brooklyn pier	251	00
At loading berth awaiting completion of coaling	42	00
Time between departure from loading berth and clearing port	23	55
Total	353	24

Port Charges.—The charges against the vessel during the period that it was in port were as shown in the following table:

[2] T. W. Cleworth, "Economies Effected by the More Rapid Turn-around of Vessels in United States Ports." Mimeographed memorandum, 1919.

PORT EXPENSES OF A SELECTED STEAMER

INWARD CHARGES		
Charges against vessel		
Pilotage from sea to anchorage	$78.47	
Towage from Red Hook to Brooklyn pier	117.50	
Taking Captain from Bay Ridge to Battery	15.00	
Wharfage (dockage)	3,100.00	
Shifting vessels by tugs	191.25	
Watching ship	56.00	
Tonnage tax (6 cents per net register ton; 3,147 tons)	188.82	
Customs fees	20.50	
Boatmen running lines at berthing of vessel	3.75	
Total inward charges against vessel		$3,771.29
Charges against cargo		
Stevedoring		
Discharging 2,713 payable tons at 62.5 cents per ton	$1,695.63	
Extra labor (overtime, lost time, tiering, etc.)	1,990.98	
Winchmen	220.80	
Clerking	503.00	
Coopering	366.50	
Watching cargo	240.00	
Lights for ship and cargo	185.00	
Miscellaneous charges—extra service of customs inspectors, etc.	181.00	
Total inward charges against cargo		$5,382.91
Total inward charges		$9,154.20
OUTWARD CHARGES		
Charges against vessel		
Pilotage at sea	$ 99.68	
Towage from pier to stream	112.50	
Wharfage (dockage)	2,400.00	
Shifting vessel by tugs	115.00	
Watching ship	144.00	
Surveys (Board of Port Wardens)	15.00	
Clearance fees (including $5 brokerage)	7.70	
Boatmen running lines at unberthing of vessel	3.75	
Additional expense incurred on account of return of vessel to port after clearance to make repairs	681.82	
Total outward charges against vessel		$3,579.45

Charges against cargo		
Stevedoring		
Loading 5,398 tons at 65 cents per ton	$3,508.70	
Extra labor (overtime, lost time, tiering, etc.)	1,421.18	
Winchmen	371.40	
Clerk hire	647.76	
Coopering	53.00	
Watching cargo	136.00	
Lights for ship and cargo	172.00	
Dunnage	258.38	
Hire of hoister	125.00	
Building bulkheads and placing dunnage	617.68	
Removing wooden lining in between decks ...	110.00	
Miscellaneous charges	94.50	
Total outward charges against cargo.....		$7,515.60
Bunkering charges		
Loading and trimming 1,539 tons of coal	$2,925.20	
Hire of hoister	57.50	
Tallying coal	53.60	
Total bunkering charges		$3,036.30
Total outward charges		$14,131.35
CHARGES NOT CLASSED AS INWARD OR OUTWARD		
Port pay-roll (15 days).....	$1,469.16	
Supplies consumed in port—15 days		
Coal	1,685.21	
Water and oil	44.59	
Interest—5 per cent on $770,500 for 15 days..	1,583.25	
Depreciation—6 per cent on $770,500 for 15 days	1,899.90	
Reserve for maintenance and repairs at 85 cents per dead-weight ton per month	2,700.30	
Insurance—hull, marine, war risk, etc.	4,818.90	
Total charges not classed as Inward or Outward		$14,201.31
Total charges		
Inward	$ 9,154.20	
Outward	14,131.35	
Others (above)	14,201.31	
		$37,486.86
Total daily expense (15 days)		$2,499.12*

*Not $4,371.45 as given by Cleworth, who included charter hire in his calculation.

Stevedoring Costs in Relation to Other Charges.—The cost of stevedoring cannot be measured alone by the amount of money expended in the handling and transfer of cargo. The time consumed in loading or discharging must be considered an important factor in determining cost because of its influence on wharf charges and overhead expenses. By using the labor of only a few men a cargo may possibly be discharged at a relatively low actual cost, but the operation may cover a period of several weeks, during which time the vessel is not earning money and the harbor and overhead costs continue to mount up. Another owner may, by the aid of a large number of men and a complete transfer equipment, unload his vessel in one day. The amount of money expended for stevedoring may be greater than in the first case, but there is a large saving in overhead costs and wharf charges.

A summary of the results of a study of the stevedoring costs for a number of vessels, showing time and pay-roll costs, is given in the table on page 23.

The vessel selected was a steel cargo and passenger steamer of 6,450 dead-weight tons (summer), a total bale capacity of 290,955 cubic feet, and a total grain capacity of 320,840 cubic feet. Its permanent bunkers held 811 tons of coal and it had 4 holds, 5 hatches, and 6 winches.

The total daily cost of holding this small vessel in port was $2,499.12, or in round numbers $2,500. This is the generally accepted figure taken in making rough averages. But, obviously, much of this expense is unavoidable. The vessel must discharge its cargo and take on coal, supplies, and freight. There is little use in pointing out how much it costs to hold a vessel in port if keeping it there is essential to its operation. What must be shown is why some of this cost is unnecessary and how it can be avoided. This will be done for this particular case and then the general principles of saving in port expenses will be pointed out.

It will be seen from this that the total cost of loading vessels in 1918 averaged about $7,760. The average time in loading was 5.37 days. Probably the smallest value that could be placed on a day's time of one of these vessels was $2,000, so that at least $10,740 was consumed in overhead expense during the loading operation. That is, the cost of stevedoring was less than the value of the time lost. Speeding up would have increased the stevedoring charges in

all probability, but the total cost of loading undoubtedly would have been reduced.

Economies That Could Have Been Effected.—The following summary of the economies that could have been effected by more careful work on this selected steamer is taken largely from Mr. Cleworth's monograph:

By More Careful Work

1. Wharfage (dockage) charged against inward voyage after discharging ceased	$ 700.00
2. Extra labor for discharge	
No steam or insufficient steam at hatch	247.30
Detention to three gangs getting ready and re-rigging	126.50
Allowance for slow working of hoist	79.20
Waiting for lights	16.23
Broken winch	8.40
3. Wharfage (dockage) charged against vessel after loading ceased	600.00
4. Direct expenses connected with return of vessel to port for repairs	681.82 *
5. Lack of steam in loading	33.30
6. Waiting for steam in bunkering	173.20
7. Loss of four days' time in returning to port (avoidable by careful bunkering)	11,925.24 *

* These expenses are unusual, but are shown because they actually occurred in this case.

By Faster Work

In addition to the economies that could have been effected by more *careful work*, large savings could have been made *by faster work*. It is impossible to give these accurately, but an estimate can be made. Considering only the most important port expenses that would accrue, whether the vessel was being worked or not, we have the following as the *daily expense* of holding the vessel *idle* in port.

Overhead charges	$2,605.82
Wharfage (dockage)	366.67
Vessel supplies	115.32
Port pay-roll	97.94
Watching ship and cargo and lighting	62.21
Total	$3,247.96

If, therefore, the stevedoring could have been speeded up by use of machinery and by other means so that five days were saved, the total saving would have been about $16,000. It is scarcely

probable that this faster work would have cost more, and it certainly would not have cost $16,000 more.

This study is given in detail because it illustrates a number of factors that must be considered more fully. It will be seen that the most important charges are for wharfage, stevedoring, and overhead, and these costs demand more extended treatment.

Wharf Charges and Dues [3]

Wharf charges are but a part of terminal charges which have been grouped and defined by Mr. C. O. Ruggles as follows:

Port terminal charges are the charges levied at a port for the use of facilities and for various services incident to the movement of traffic through a port. In this report these charges have been divided into (1) charges against the vessel, (2) charges against the cargo.

The charges against the vessel have been separated into *(a)* major charges, including pilotage, towage, dockage, loading and discharging, bunkering, and dunnage; *(b)* minor group, consisting of harbor master's fees, port warden's fees, and various miscellaneous charges.

The charges against the cargo are divided into *(a)* those mainly connected with water operations, including wharfage, lighterage, and floatage, and *(b)* charges mainly connected with shore operations, comprising elevating, switching and belt-line charges, and storage.

The division here made between charges against the vessel and charges against the cargo is, of course, not strictly accurate. In the last analysis all charges must be borne by the cargo. Stevedoring has been included in this report among the charges levied against the vessel; it might as well have been included in charges against the cargo. This charge, like others actually paid by the vessel, must be included by it in the ocean freight rate imposed upon the cargo. Any division of port charges, therefore, is more for convenience in analysis than it is to indicate the incidence of charges.

In attempting this study of port terminal charges, it has been necessary to define the terms to be used in the hope that the different practices in the various ports might not result in confusion in the information furnished.

[3] Taken largely from C. O. Ruggles, "Terminal Charges at United States Ports." Report to United States Shipping Board. Government Printing Office, 1919.

The following are the definitions which have been used in seeking information:

Charges against the Vessel—*Major Group.*—"Pilotage" includes all charges for working a ship into and out of a harbor and through a channel or passage; it is based on some unit, such as draft of vessel or tonnage. Pilotage is sometimes commuted into a term license.

"Towage" includes all charges for employment of tugs or towboats for assisting vessels into and out of the harbor, for docking and undocking, and for moving vessels and lighters from pier to pier.

"Dockage" includes all charges levied against vessels for the use of berthing space, whether for loading, discharging, repairs, or other reasons. Use of berth beyond an agreed time allowance is sometimes called "penalty dockage." There is included under this head any charge for the use of buoys.

"Loading and discharging cargo" includes stevedoring and all forms of mechanical handling, such as cranage, and any miscellaneous charges that are incurred in connection with the transfer of cargo from ship to pier, or pier to ship, all sorting and stacking on the wharf, including charges for stowing and trimming on vessel. Stevedore labor rates also are included under this heading.

"Bunkering" includes all charges for loading coal into a ship's bunkers for its own use, exclusive of the price of coal.

"Dunnage" covers the expense of preparing a ship for the stowage of cargo. It includes all material necessary for safe and efficient stowage, such as boards, coins (extra barrel heads), cordwood, braces, and ship-lap, and the cost of installation.

Minor Group.—"Harbor dues" or "harbor master's fees" include all fees imposed by the port to cover expenses of administration. They comprise such charges as those imposed for indicating anchorage, shifting vessels, clearing wharf, and the like.

"Port warden's fees" include all charges for surveys held on board or on wharf or at any warehouse, storage of cargo, or damaged goods; for surveys of hull, sails, spars, and rigging of any damaged vessel; or for valuation or measurement of vessel.

"Miscellaneous charges" include all fees and charges not otherwise classified. Illustration of such fees are those levied for the services of a watchman, or a tally clerk, weighing and measuring expenses, running lines for vessels, furnishing tarpaulins, charges for water furnished, lighthouse fees, brokerage fees for entering goods at the customs, inspection of cargo, fees for making out bills

of lading, and charges for various shipping documents, and ship brokerage fees when vessel is in the chartered freight service. Sometimes these fees are commuted into annual payments.

Charges against the Cargo—*Definition of Items in the Account.*—"Wharfage" includes all charges against freight for the use of wharves for freight passing over the wharf. These charges are sometimes called "tolls." Preferential assignment of space on a term basis to shipping agents is included under wharfage, but this should be distinguished from lease of wharves to steamship companies, which should be included under dockage.

"Lighterage" includes all charges for the transportation of goods by lighter in a harbor. This charge usually includes the loading into and discharging out of lighters. Charges made for car floats are included under this heading.

"Elevating" includes charges for services of both land and floating elevators.

"Switching and belt-line charges" include the charge made by switching or belt-line railways.

"Storage" includes all charges for freight remaining on wharf beyond a specified time; also all warehouse and other charges for temporary safe-keeping, including bulk storage of grain, cotton, and the like. These charges are to be distinguished from demurrage, which is a charge applied to the transportation vehicle rather than to the cargo.

Some charges of importance, dry-dockage, demurrage, and drayage have not been included in this report. Dry-dockage is made only when the ship is in a dry-dock for repairs. Demurrage is the charge made for the detention of a vessel beyond an agreed number of days allowed for its loading or discharging. Obviously this would vary according to the size of the ship, the demand for its service, and various other circumstances. From the characterization of these charges it will be seen that a vessel might enter and clear a port many times without occasion for either of them being paid. Although drayage is an important charge in some ports, it has not been possible to secure accurate information concerning it. The drayage charge of significance in this study is that which would obtain for cartage between piers, between piers and storage warehouses, between piers and railway terminals and vice versa. In cases in which information has been furnished differentiation has not been made between the service connected with the coördination of rail and water carriers and that of local deliveries.

In addition to the Federal regulation of quarantine, there are

certain local health or quarantine fees for sanitary inspection and fumigation services, but the information furnished on these charges was so unsatisfactory that in view of their minor importance they have been omitted.

Definitions Vary at Different Ports.—Examination of the data in Part II of this report will indicate that the definitions of port charges here given do not obtain at all ports. Indeed, the conspicuous lack of any standardization of terms in this field is one indication of the fact that port charges have not received the consideration to which they are entitled. A few concrete examples will indicate the variety of usage employed. At New York and Philadelphia the term "dockage" is rarely used. Although charges are made against the vessel at these ports, it is called "wharfage." As has been seen, wharfage has been defined in this report as a charge against the cargo. Therefore, what is usually referred to in New York and Philadelphia as wharfage is called dockage in this report. At San Francisco, until recently, wharfage was used to designate the charge made for cargo remaining on the wharf after a specified time. In an amendment to the harbor rules, regulations, and rates of that port, effective September 1, 1917, the board of State harbor commissioners substituted the term "demurrage" for "wharfage." At Seattle the charge made for leaving cargo on the wharf beyond a prescribed time is called "wharf demurrage"; at New Orleans such a charge is in some instances called demurrage. This is confusing. The term demurrage properly applies to the detention of a ship or vehicle. In this report the charge for leaving cargo on a wharf after a prescribed time is called storage. Possibly a new term, such as "penalty wharfage," should be given to this charge, to distinguish it from storage in warehouses.

Of these various terminal charges, those for wharf service are especially important because they are relatively large and because they "are used for purposes of what may be called traffic strategy or port strategy, being collected as a separate charge for a special service, or absorbed in the freight rate, or waived, as the exigencies of the port or the owners of the terminal facilities, especially of railroad owners, may require."

Difference between Dockage and Wharfage.—The charges for wharf service consist of "dockage" and "wharfage," which Ruggles distinguishes from each other as follows:

Dockage is a per diem charge proportioned to the space occupied

by the ship alongside the pier or wharf; while wharfage is proportioned to the quantity of goods passing over the wharf to or from the vessel. Generally speaking, these are alternative modes of payment, the owner relying on one form or the other for his revenue. It is not usual to charge the vessel for occupying a berth while loading or discharging cargo against which wharfage is charged. Dockage may be charged against such a vessel for occupying the berth for an unreasonable length of time, or against a vessel at berth for any purpose other than receiving or discharging cargo. This is the common practice, but in some cases, especially in ports where terminals are publicly owned and publicly operated, both charges, and indeed some additional charges, are collected.

Difference in Application of Charges.—The difference in methods of applying these charges may be shown by comparing the practice at New Orleans with that at New York.

At New Orleans the wharves owned and operated by the public are the ones chiefly used by vessels engaged in foreign and coastwise trade. The total gross tonnage of the ocean vessels docking at the public wharves in 1916 was 4,510,000 out of a total of 5,792,000 arriving at the port. The State secures its wharf revenue from five forms of charge: (1) from dockage, based on gross tonnage and the length of time the berth is occupied, imposed on all seagoing vessels; (2) from wharfage, locally called tollage or tolls, imposed since November, 1915, but not before, on all foreign and coastwise traffic at a flat rate of 5 cents per ton of 2,000 pounds; (3) from sheddage, a charge for the use of piers provided with sheds, at the rate of 1½ cents per gross registered ton for the first 21 days and ¾ cent for the next 3 days. It will be seen, therefore, that this is essentially a dockage charge for the use of a particular kind of wharf. (4) A fourth form of charge is made for preferential assignments of wharves to water carriers for which "assignment rental" is collected at the rate of 3 cents per square foot per annum for wharf space occupied. As the charge indicates, it entitles the ship only to a preferential use, not to absolute control of the wharf or part thereof assigned. This charge is also of the nature of a dockage charge, but is not in lieu of it or of any other charge. (5) Still another form of charge is the license, levied against river craft of various kinds. It is graded according to the size and character of vessel and ranges from $36 to $120 per year.

Pier Rent.—At New York the revenue of the public wharves is derived from "rent" and from "wharfage" (properly "dockage"),

rent making up by far the larger amount. When the city rents a pier it surrenders all right to make any charges other than the rent itself, and thus there is a sharp contrast to the situation at New Orleans. The lessee may make any charges that he prefers, and in almost all cases the charge is a dockage charge proportioned to tonnage and time at berth.

It will be seen from this one illustration that it is difficult to compare wharf charges. The problem is further complicated by the practice at piers owned and operated by railroads.

In general it may be said that the railroads do not make a dockage charge against a vessel while it is loading or discharging cargo subject to wharfage. The railroad terminal tariffs have a much larger number of specific commodity rates than is usual at public piers, and what is more confusing, the wharfage charge is usually combined with a handling or a storage charge and often with both. But the greatest confusion is due to the fact that the charge is collected as against some traffic and is waived with respect to other traffic. This applies to wharfage, the charge against the cargo rather than to dockage. Without attempting to go into the history of the railroad practice of absorbing the wharfage charge it may be said that it has been adopted in part to protect the business of the port and in part to protect the traffic of the roads. The longer the haul a road has the better able it is to treat the terminal as part of the railroad and make no separate charge for its use, and the more likely it is, therefore, to absorb the wharfage. At Boston, the roads will absorb a rather high wharfage charge in a switching rate. At Baltimore the Pennsylvania absorbs it if it gets a line haul, while the Baltimore & Ohio does so only when it earns a line-haul revenue of a stipulated, though small, amount. At New York and Philadelphia there is no wharfage charge at the railroad piers, though in the case of New York vessels rarely dock at the railroad piers. At New York vessels are subject to heavy dockage or rentals at the city piers on the Manhattan side.

Competition between the rail carriers is another factor determining whether a separate charge is made against traffic using a railroad water terminal. The method of absorption employed generally at the South Atlantic ports and at Mobile illustrates the effect on railroad policy, both of competition and of distance. Traffic from beyond a certain defined territory, roughly, south of the Ohio and east of the Mississippi, pays no wharfage, while traffic originating at or

destined to points within that territory does pay it, unless such points are competitive. The Galveston Bay roads absorb wharfage at Galveston and Texas City on all commodities, with a few exceptions of traffic originating at or destined to points outside of Texas, while Texas traffic pays the charge in addition to the rail rate. The rule at Seattle is constructed on the same general plan, but it introduces another condition—the origin or destination of traffic at the water end of the movement.

It should be pointed out that the railroads also absorb the wharfage charge against traffic passing over public piers as well as their own. When in 1915 New Orleans was in need of more revenue from its wharves it left untouched its old charges against the vessel and added a low flat rate on freight, fully expecting that the railroads would absorb it, and this the railroads promptly did. The transcontinental lines follow a general policy of absorbing the California State "tolls" or wharfage, though they do not absorb on all traffic. At the present time (December, 1918) the proposal is being discussed at San Francisco to reduce greatly, if not to eliminate, all charges against vessels in the hope of attracting more vessels to the port, and to make good the loss of revenue by increasing the wharfage charge with the expectation, no doubt, that the railroads will absorb it, thus giving San Francisco what would amount to a lower railroad rate.

It will readily be seen that the outcome of this policy of absorbing the wharfage on some traffic and not on other is to introduce an element of discrimination in the interest of the carrier or of the port, and to render it well-nigh impossible accurately to compare the charge either as a measure of service or as a burden of commerce.

Although it is impossible, therefore, to compare wharf charges, there are available several publications which can be used to obtain the charge made at any one port. The points that we want to make here are that these charges are relatively large and that they vary between wide limits. Since they vary, it is possible for the shipowner to make large economies by studying the situation carefully and using those wharves or ports at which he can obtain the most favorable rates. Since they are large and are generally based on time at berth, it is essential that the time of the vessel in port be reduced to the lowest possible minimum. Methods of reducing this time will be considered later.

Cost of Stevedoring

The actual cost of handling cargo varies with a great many factors, the most important being the harbor facilities, the kind of cargo, the type of vessel, and the wages and efficiency of the longshoremen. The cost is relatively low if the harbor and transfer equipment is adequate, if the cargo can be handled in bulk, and if the wages are low; and it is high if the cargo must be handled by many highly paid and inefficient laborers at a port not equipped with modern conveniences.

Even under the most favorable conditions the cost of stevedoring is large as compared with other direct operating expenses of the vessel. From the few studies that have been made on this subject it would appear that stevedoring accounts for 25 to 35 per cent of the total direct operating expenses, which include wages, fuel, repairs and maintenance, port charges, agency fees, subsistence, stores and supplies, management, loading and discharging, but do not include insurance, interest, and depreciation.

It is a common saying that it costs more to move a barrel of oil over a New York pier and place it in a vessel than it does to carry the barrel from New York to London, and yet some people argue that New York is one of the best equipped ports in the world. Under the most unfavorable conditions—sometimes encountered at the largest ports, such as at New York—the cost of handling cargo becomes enormous.

Conditions differ so greatly that it is impossible to make any general statement showing the costs to be expected. Nor are there available figures to show the cost of handling even one type of cargo at different ports of the world, although shipping and port guides give some indication of the stevedore rates. We can, however, choose some illustrations to indicate the general trend of costs in Philadelphia and New York.

Stevedore Rates at Philadelphia.—The statement following gives the *contract stevedore* rates of Murphy, Cook & Company, one of the largest stevedoring firms in Philadelphia. Most of the important commodities handled by this firm, with the rate on each, are listed. It will be noted that the rate on general cargo is the same for both loading and discharging ($1.10 per ton, weight or measurement). It would seem perhaps that the cost of loading would be

Example of Stevedore Rates

Messrs..... *of* .....

We hereby offer to discharge and /or load your vessels at the Port of Philadelphia at the undernoted rates, except when bound by charter, or in the case of strikes, lockouts or other conditions beyond our control.

Discharging		Loading	
Bombay, Calcutta cargoes, per Calcutta or Bombay ton	$ .56 per ton	Ammunition and /or explosives	$ 3.35 per ton
Bale cargo	1.20 " "	Dynamite (50 per cent extra)	
China clay	.98 " "	Automobiles	1.35 per ton measurement
Chalk	.98 " "	Billets, bars and pig iron	1.51 " "
Colombo cargo	.75 " "	Beams (structural steel)	2.85 " "
General cargoes (per ton weight or measurement)	1.10 " "	Barrel and /or drums of oil, or other barrel cargoes:	
Iron (pig)	1.15 " "	Full cargoes at refinery	
Lath	1.50 " "	From dock .23 per bbl.	1.15 " "
Ore	.75 " "	From dock and lighters .27 per bbl.	1.35 " "
Steel or iron scrap	2.50 " "	Part cargoes .29 per bbl.	1.45 " "
Skins (wet), per ton of 2,240 lbs., C. or B. cargo	1.10 " "	(Out of city) .30 per bbl.	1.50 " "
Sulphur	1.00 " "	Barbed wire	1.63 " "
Skins, if wet, quoted above, if dry on Bombay or Calcutta cargo basis.		Case oil:	
Wool:		Full cargoes	.04 per case
Compressed	1.80 " "	From lighters	.05 " "
Not compressed	.60 per bale	Coil wire	1.31 per ton
		Car material	1.31 per ton measurement
		Carbon black	1.31 " " "
		Cotton	1.50 " " "
		Flour and other bagged cargo	1.10 " " "

FROM RIVER PLATE PORTS

Maize and /or linseed—in bags overside .....$1.10 per ton

Maize and /or linseed—in bags on dock (same rate plus labor for trucking and piling)

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General cargo (weight or measurement)..	1.10	"	"	
Hay	1.60	"	"	
Ingots	1.51	"	"	
Iron—scrap	2.45	"	"	
Iron plates	1.80	"	"	
Locomotives and /or machinery or other heavy lifts, including crane hire, when loaded at Pier "G" and /or Eddystone, on the entire shipment.....	4.80	"	"	
Lumber	1.50	"	"	
Meats	1.10	"	"	
Oil cake	1.10	"	"	
Oats	7.50	per	1,000 bushels	
Oats (filling into and stowing in bags and feeders)	19.00	"	"	" Extra
Oats (full cargo—bagged)	24.00	"	"	"
Pipe	1.55	per	ton	
Rails—under 40 ft. long and rail equipment	1.55	"	"	
Rails—over 40 ft. long and rail equipment	2.00	"	"	
Staves	1.50	"	"	
Tobacco	1.50	"	"	
Wheat and /or all heavy grains.....	5.50	per	1,000 bushels	
Filling and stowing in bags and feeders..	16.50	"	"	" Extra

Other commodities by special arrangements.

NOTE.—The foregoing rates are based on the usual custom of Philadelphia delivery, and any expenses incurred for trucking, piling cargo, etc., on the dock to be paid for by the ship. (Over six (6) men to each gang on the dock.)

In event of our discharging or loading any vessels at lower rates than those named, we agree to give you the benefit of such reduction, and in case of increased cost of labor, owners to pay such increase.

We agree to give the ships the best possible dispatch and attention. Cargo in peaks, bridges, tanks, poops, lazarets, by day's work.

We are covered by insurance against accidents which may occur to our men while employed by us to comply with the Workmen's Compensation Act, in the State of Pennsylvania, for which an additional five per cent will be charged.

Steamships to furnish all necessary steam, winches, runners, and slings for working the cargo. The stevedores furnishing the men to work at the winches, the ship paying the prevailing rates for the commodity handled for each man so furnished. Should steamers' winches not be available, owners to pay the cost of hoisting charges.

Should men be employed by the ship to assist in any work, such men to be paid the prevailing rates for the commodities handled.

LABOR RATES

	Day Work per hour	*Overtime per hour*	*Meal Hour per hour*	*Overtime per hour*	*Meal Hour per hour*
General cargo .	$ .85	$1.30	$1.70	$ .50	$ .85
Foremen—do ..	1.35	2.05	2.70	.70	1.35
Oil—in city ...	1.00	1.50	2.00	.55	1.00
Foremen—do ..	1.50	2.25	3.00	.75	1.50
Grain	.95	1.40	1.90	.50	.95
Foremen—do ..	1.45	2.15	2.90	.70	1.45

Oil—Point Breeze and Gibson's Point

$11.50 per day or one-half day.
$15.50 per day or one-half day or night or one-half night overtime.
$2.30 per hour meal hour.

Foremen

$15.00 per day or one-half day.
$22.50 per day or one-half day or night or one-half night overtime.
$3.00 per hour meal hour.

Explosives

$12.50 per day or one-half day.
$16.00 per day or one-half day or night or one-half night overtime.
$2.50 per hour meal hour.
Overtime, $1.00 per hour; $2.50 per hour meal hour.

Foremen

$18.00 per day or one-half day.
$25.00 per day or one-half day or night or one-half night overtime.
$3.60 per hour meal hour.
Overtime, $1.50 per hour; $3.50 per hour meal hour.

The basic day is from 8 A. M. till 5 P. M. (8 hours). All other time is OVERTIME, and the rate for all labor for overtime is governed by the National Adjustment Commission.

This agreement to commence on———, and to remain in force until ———, 19—.

MURPHY, COOK & Co.

Witness:

.....

We hereby accept the above offer of Messrs. MURPHY, COOK & COMPANY, to do the stevedoring work (except when bound by charter) of all steamers under our management, and subject to all conditions named in this contract.

Witness:

.....

.....

Dated at ———, this —— day of ———, 19—.

the larger because it involves stowing in the hold. Perhaps the stevedore does make a larger profit on the unloading, but it must be remembered that breaking out of cargo is almost as difficult as the stowing, particularly as the goods must be raised.

The rates vary between wide limits, according to the character of the cargo. The lowest loading rate ($1.10 per ton) is given to those articles most easily handled because of their method of packing, including bagged materials, meats, oil cake, general cargo, and case oil. The highest rates are on those that are very dangerous (dynamite, $5.02 per ton) and those that require special machinery and a large number of men (locomotives $4.80 per ton). The lowest discharging rates are quoted on East Indian cargoes, ore, china clay, and chalk. The East Indian cargoes consist of goods that can be easily and roughly handled, while ore, china clay, and chalk can be discharged into lighters by use of clamshell buckets. The highest rate is on steel or iron scrap, the discharge of which requires many men and may require special equipment.

In almost all cases these rates must be considerably increased to cover the "extras," or charges for extra labor and equipment, which may amount to a large percentage of the total bill. But, on the other hand, the rates include a profit for the stevedore and are higher than the actual cost. It is probable, therefore, that the cost of the same operations to a steamship company doing its own stevedoring is not greatly different.

Satisfactory Statistics Lacking.—Satisfactory statistics on the subject of stevedoring costs are lacking, even for the port of New York, to which so much attention has been paid, although the New York and New Jersey Harbors Facilities Commission has made an investigation of this matter which became available in April, 1921.

Shipping Board Calculations.—Perhaps the best study is that made by the Ports Facilities Commission of the United States Shipping Board, shown in the table on the following page. The cost is made up of four items: stevedoring, tallying and clerking, watching, and dunnage, and is shown for two periods—the fall of 1913 and the fall of 1918.

Most of the vessels carried general cargo. The striking disclosures made by this table are: (1) the high cost of loading in 1918, (2) the large increase in costs since 1913, and (3) the difference of 56.7 cents between the average costs of loading and unloading in 1918. If the figures show the true conditions, as they were designed to do, the cost of loading in New York in 1918 was more than $1 greater than the contract stevedore prices in Philadelphia a year later, after further increases in longshoremen's wages. The cost was less on the average for coastwise vessels than for deep-sea vessels, and there were large differences between the costs of different companies.

The fact that the cost of unloading was considerably less than the loading cost in 1918, although the two were almost equal in 1913, is to be partly explained by the smaller percentage of general cargo vessels to be unloaded in 1918. But it is probably true that unloading costs at most modern ports and with most cargoes are less than loading costs.

It will be seen from the table on page 65 that the wages of longshoremen in the period, August, 1918, to January 1, 1919, at which time this study was made, were 50 cents and 65 cents an hour, whereas in January, 1920, they were 80 cents an hour. The investigation therefore falls far short of representing the cost of stevedoring in New York at the present time. The costs at other ports, even for 1918, are not available, but some hint of them is contained in the level of longshoremen's wages, shown in the table referred to above.

SUMMARY OF RESULTS OF STEVEDORING STUDY MADE AT THE PORT OF NEW YORK BY THE UNITED STATES SHIPPING BOARD

	Loading, 1913: 33 vessels, 8 of which were coastwise; all loaded with general merchandise.		Loading, 1918: 32 vessels, 8 of which were coastwise; all loaded with general merchandise.		Unloading, 1913: 33 vessels, 8 of which were coastwise; 24 carried general merchandise.		Unloading, 1918: 26 vessels, 8 of which were coastwise; 15 carried general merchandise.	
	No. of vessels	Cost per ton	No. of vessels	Cost per ton	No. of vessels	Cost per ton	No. of vessels	Cost per ton
Average cost of loading or unloading	33	$0.584	32	$2.158	33	$0.588	26	$1.591
Average stevedoring cost of loading or unloading	28	.458	31	1.755	28	.562	25	1.404
Average tallying and clerking cost of loading or unloading	25	.080	28	.160	25	.088	21	.159
Average watching cost of loading or unloading	18	.025	27	.070	18	.029	18	.072
Average dunnage cost of loading or unloading	8	.011	10	.125	4	.028	4	.022
		Days		Days		Days		Days
Average time of loading or unloading	27	4.22	26	5.37	27	3.5	21	3.03
		Tons		Tons		Tons		Tons
Average number of tons loaded or unloaded per vessel	33	3732	32	3596	33	3064	26	2088
				Per cent		Per cent		Per cent
Per cent of total tonnage loaded from or to								
Piers				64		79		64
Lighters				36		13		36
Unspecified				0		8		0

Methods of Reducing Terminal Costs and Time in Port

It has been pointed out that a saving of several thousand dollars can be made in port overhead expenses for each day eliminated from the time spent in port and that wharf charges can be reduced several hundred dollars for each day eliminated. The economies resulting from faster stevedoring are not so apparent, but unquestionably quicker stevedoring means cheaper stevedoring, except in those cases where speed is made by working overtime at higher costs. If greater speed is the result of mechanical appliances or more efficient work, the total cost is lowered. These three major items in port expense depend, therefore, upon the time in port, and it becomes necessary to inquire into the means that may be taken to reduce this time. Some of the means will be considered in more detail in future chapters, especially in those on transfer, but it is best to summarize them here.

If the shipowner can secure from these suggestions a hint that will enable him to eliminate one day in port, this book will have served its purpose. The lowest freight rates in the world are those of the Great Lakes, where time in port has been reduced to such a point that the vessels can make large earnings in spite of high wages, low freight rates, and an eight months' operating season. If the deep-sea American merchant marine is to prosper in similar fashion, the turn-around of the individual vessels must de decreased. Decrease will not come immediately as a result of greater speed of the vessel, for that involves increased costs, but it must come as a result of the elimination of some of the time in port. In September, 1919, the average time spent by the United States Shipping Board vessels in London was 40.4 days, and this had been reduced to 29.6 days in November, partly as a result of the activity of the Board's agents. A reduction of over 10 days in port time cannot be expected in many instances, but smaller reductions can be made by the adoption on the part of the several interested agencies of one or more of the following suggestions:

Quick dispatch is attained by maximum speed in loading and discharging. Obvious as this may sound, there is a great deal to it, because the actual loading or unloading of the vessel is concerned with processes very remote from the ship's side. There are many factors involved in addition to the mere speed of the hook between

hatch and wharf. Some of the factors of rapid loading and discharging should be carefully considered.

Formulation of the loading plan well in advance is the foundation for quick dispatch. If the larger part of the freight to go into the vessel has been booked and the distribution of the same in the ship carefully calculated well in advance of the time when the ship is to load, it is possible to feed the cargo into the ship in a steady stream in the order in which it should come. If cargo can move quickly without interference and without congestion on the pier or in the hold there will be saved all those vexatious delays due either to congestion or to the failure of the goods to arrive on time.

Prompt delivery is important in loading or unloading the vessel. Prompt delivery while loading is necessary to avoid delays. As the size of ships has grown much more rapidly than the wharf capacities, it is essential that delivery be taken of cargo discharged from the ship as promptly as possible in order to remove the same from the wharves and not to congest the wharf area for the further discharge of freight from the vessel. Rapid transfer is dependent very largely upon the dispatch with which freight arrives or is taken away.

Adequate machinery is of the greatest importance. Probably more attention is given to this subject than to any phase of port development. The contestants in favor of the ship winch and cargo masts as against the adherents of the electric crane are constantly before the public with their various arguments. The difference between the two, so long as the movement is positive and rapid—positive because it handles the draft with dispatch, and rapid because of the maximum frequency of the cycles possible—still leaves considerable room for discussion as to the relative merits. The question of transfer machinery undoubtedly is important. There is much room for improvement and for new designs, particularly special designs for the continuous motion of handling freight of a uniform size and weight. However, the main delays occur some distance away from the picking-up point. Nevertheless, in the case of large packages weighing more than a ton each, adequate derricks either on the wharf or afloat are absolutely essential to quick dispatch. For instance, at Baltimore at the beginning of the World War, it took more than an hour to load a crated army truck from the wharf side. After the institution of a lighterage and floating derrick system, with a derrick sufficiently powerful to lift easily

a crated 6-ton truck, the loading time for these trucks was reduced to less than fifteen minutes. Even such a large package as a locomotive completely assembled can be handled with comparative ease with the proper machinery.

Avoiding congestion is more important than the relative difference in machinery, as various types of transfer machinery have been well developed to date. Congestion in and about our ports from the area immediately about the ship, both wharf and slip, and into the classification yards of the railroads is the main cause of delay, high cost of loading, and of slow turn-around. There are numerous points where this congestion can be avoided and must be avoided in our future port development if our merchant marine is to prosper.

Avoiding congestion at the picking-up point or deposit point opposite the ship's hatchway is important. If in discharging a vessel a draft must "hang" because the draft preceding it has not been removed from the point of deposit, this time is lost. One of the first rules in handling cargo is not to let the draft hang. In order to avoid this it is necessary to have as large a point of deposit as possible. One advantage of the crane over the cargo mast and tackle is the greater area on which goods may be set down upon the wharf.

The size of the wharf deck is of even greater importance. Much of the congestion at New York is due to the fact that the piers were built for small ships many years ago. The large ships of to-day can discharge upon the average old pier far more cargo than it can hold, even if the goods are tiered to its shed roof-stringers. Obviously, when the cargo is being worked and delivery is being made, either to the ship or to the consignee, it is quite impossible to pile to full height and to leave only a few aisles. There are so many different marks that the goods will become mixed unless there is a sufficient area to pile consignments separately and to leave large aisles between the piles. If the aisle space is encroached upon there is insufficient room for the longshoremen to work; every one interferes with every one else, and the piled goods and the goods on the hand trucks are constantly in collision. Future wharves must have a very much greater area—several times the area of the average New York pier. In getting along with what limited wharf space we have, careful planning to secure prompt delivery of goods as wanted for stowing is necessary.

Working all the hatches is essential to quick dispatch. This

again is dependent upon adequate machinery and adequate deck area of the wharf. With all four or five hatches being loaded simultaneously the confusion on the wharf is increased. Unless there is plenty of room and, in addition, adequate machinery for handling, tiering, trucking, etc., it is an extremely difficult matter to keep all hatches busy, and costly delays constantly occur.

Both sides of the ship should be worked, wherever possible, at the same time. In particular, the small packages should be coming aboard from the wharf side, while lighters should be loading the heavy packages and such consignments as grain in bulk and coal from the water side. If "breasted off," the ship can be bunkered from both sides at the same time.

The design of the wharf and its proper relation to rails, drays, warehouses, lighters, etc., is necessary to the intensive working of the ship. From what has been said it is obvious that a modern wharf must be designed with a very much greater area than we have been accustomed to in the past. At the same time, with the growth of ships, particularly their increased beam, it is necessary to make the water area alongside the wharf more ample. This is especially true at New York, where the slips between the piers are as narrow in proportion as the piers themselves and similarly congested. This design at New York is due not to desirability of the plan, but to the fact that the city had riparian rights to land under water and to the water front at the ends of the streets. Therefore, the piers correspond in width to the width of the streets and the slips to the width of the city blocks. When people to-day declare that the New York piers are properly designed and new piers should be built like them it only goes to prove that man is far more a creature of habit than of imagination. New York piers never were designed for efficiency. They were built to fit certain legal and physical conditions. With the growth in the size of the steamer and the growth in the size of the lighter that is serving the steamer from the water side, the slips to-day are hopelessly congested. This congestion in many cases reduces the capacity of each slip from two vessels to one, it being impossible to load vessels at both sides of the slip. Therefore, ample room for the lighters in the slip is just as important as ample deck room on the wharf or pier. It has been estimated that the deck area, either single-floor or double-deck tier, should be equal to ten times the number of square feet of cargo capacity of the

largest vessel using that wharf.[4] Likewise, the width of the slip should be four times the beam of the largest vessel using the slip. Where these conditions are not found the wharf superintendent and his staff are hard put to overcome the difficulty.

In addition to the wharf design as to area and to its ability to stand up and carry the load put upon it, there are other factors affecting the degree of congestion. Wherever there is a *harbor-belt railway* connecting with the main trunk lines using the wharf, provision must be made for the freight cars to be brought within convenient distance from the ship. At the port of New York no such lines exist, and railroad cars are not brought alongside the wharf to load the ship. Their contents are unloaded, put upon lighters, and towed to the pier or the ship. The narrow piers receive a lighter on one side to unload on to the wharf. In all cases where the freight is not loaded overside from lighters it is trucked across the pier and loaded into the ship. So, at least, is the theoretical system of lighters and narrow piers. It must be remembered also that only a portion of the freight can be loaded directly from lighters into the hold. Freight should be spread out and sorted in order to be loaded properly and, to a large measure, should also be assembled in advance of the loading of the vessel.

Warehouses in their relation to the wharf have undergone an evolution in the United States in the last two or three years. A great deal of the congestion on the wharf can be avoided by planning the warehouses within electric trailer-truck service distance. This has been well accomplished at the new quartermasters' supply bases at several of our ports. By being able to hold freight in warehouses adjacent to the piers, it is possible to clear the piers almost immediately, or to marshal the cargo and bring it to the ship's side in a regular and steady flow according to the cargo plan.

Skilled personnel is of the greatest possible importance in all of this work. This includes skilled personnel from the pier superintendent to the longshoremen. The skill of all of these persons requires practice and experience; it also requires close study. Unless an individual has great ability and a type of mind that will cause him to work things out for himself, experience and practice alone will not make of him a chief stevedore or a wharf superintendent.

[4] R. S. MacElwee, *Ports and Terminal Facilities.* McGraw-Hill Book Co., 1918.

The successful man is the one who knows more than the mere routine of his vocation. He must know the reasons for his duties and their relation to the whole. Then, with imagination he can make constructive suggestions and direct others. It is a very difficult task with which we are confronted in this volume. The prime object is to bring between two covers the best experience of many others in such a form that the years of apprenticeship necessary to acquire skill and experience may be shortened and methods of thought upon the prime reasons for doing things may be developed in the ambitious young wharfinger. Only through training a personnel, skilled in understanding the problems involved and in ability to carry on, can we hope to make our American merchant marine a financially profitable business enterprise. Unless it is, its failure is unavoidable.

Increased Profits by Skillful Stowing

Loading to Maximum Capacity.—To make the greatest profits during a voyage a ship must be loaded "full and down to her marks." The vessel must carry both her maximum dead-weight capacity and her maximum cubic capacity. If a ship is loaded entirely with pig iron it will be lowered to its marks and still will be partly empty. If it be loaded with cotton, it will be full, but will be high out of the water. As most freight contracts read that freight is paid "by weight or measure at ship's option," one will see that the company is charging a certain price per ton by weight if the goods are heavy, and a certain amount per 40 cubic feet, that is, by measurement, if the goods are light. Loading to maximum weight and volume, therefore, is an important factor. Of course, the chief stevedore must take his freight as it comes. It is much easier for him to load four vessels at one time than to load one, because he has a greater choice in the shifting of his cargo according to its nature. However, through coöperation between the men on the wharf and the freight agent who books the cargo, and through planning the enfreightment in advance, a great deal may be done "to have her full and down to her marks."

Kinds of Tonnage.—The various types of tonnage must be clearly in mind, and they may be reviewed here as an aid to further progress in this volume. The measurement cargo ton of 40 cubic

CARGO SPACE REQUIRED FOR SOME OF THE PRINCIPAL EXPORT COMMODITIES

(Space required for 1 ton of 2,240 pounds, expressed in cubic feet.)

Commodity	Unit	Cubic feet	Commodity	Unit	Cubic feet
Barley	Bulk	58	Oats	Bulk	55–72
	Bag	63–84		Bag	77–88
Cement	Barrel	36	Ore (iron)	Bulk	12–17
Coal:			Petroleum and products	Barrel	59–63
Anthracite	Bulk	35		Case	45–65
Bituminous	....do	42	Potatoes	Barrel	65–85
Coke	....do	85–100		Bag	55–65
Corn	..do	50	Rye	Bulk	50
	Bag	56–60		Bag	54–58
Cotton	Bale, high density	70–90	Steel (bars, billets, ingots, plates, etc.)	Piece	10–15
	Bale, compressed	120–130	Sugar	Barrel, granulated	54–62
Flour:				Bag, raw or granulated	42–50
Corn, rye, wheat	Barrel	65–73	Tobacco	Bale	100–162
	Sack	52–55		Hogshead	70–230
Lumber:			Wheat	Bulk	47
White-pine planks	Piece	70		Bag	65
Oak planks	....do	48			
Meat:					
Bacon, hams, etc.	Box	46–63			

NOTE.—The above figures are taken principally from "Stowage Factors for Ship Cargoes," published by the War Trade Board. *See also*, "Stowage of Ship Cargoes," by Thomas R. Taylor, Misc. Series, No. 96, U. S. Bureau of Foreign and Domestic Commerce; sold by Superintendent of Documents, Washington, D. C., for 35 cents.

feet is probably based upon wheat, as a ton of this commodity occupies and requires 40 cubic feet of space. The accompanying table shows the stowage factors of some important commodities, that is, the space occupied by a long ton of the commodities as they stow in a ship.

There are five kinds of tonnage in use in the shipping business. They are dead-weight tonnage, cargo tonnage, gross, net, and displacement tonnages.

1. *Dead-weight tonnage* expresses the number of tons of 2,240 pounds that a vessel can transport of cargo, stores, and bunker fuel. It is the difference between the number of tons of water a vessel displaces "light" and the number of tons it displaces when submerged to the "load water line." Dead-weight tonnage is used interchangeably with dead-weight carrying capacity. A vessel's capacity for weight cargo is less than its total dead-weight tonnage.

2. *Cargo tonnage* is either "weight" or "measurement." The weight ton in the United States and in British countries is the English long or gross ton of 2,240 pounds. In France and other countries using the metric system a weight ton is 2,204.6 pounds. A "measurement" ton is usually 40 cubic feet or 1.133 cubic meters, but in some instances a larger number of cubic feet is taken for a ton. Most ocean package freight is taken at weight or measurement (W/M), ship's option.

3. *Gross tonnage* applies to vessels, not to cargo. It is determined by dividing by 100 the contents, in cubic feet, of the vessel's closed-in spaces. A vessel ton is 100 cubic feet. The register of a vessel states both gross and net tonnage.

4. *Net tonnage* is a vessel's gross tonnage minus deductions of space occupied by accommodations for crew, by machinery for navigation, by the engine room and fuel. A vessel's net tonnage expresses the space available for the accommodation of passengers and the stowage of cargo. A ton of cargo, in most instances, occupies less than 100 cubic feet; hence, the vessel's cargo tonnage may exceed its net tonnage and, indeed, the tonnage of cargo carried is usually greater than the gross tonnage.

5. *Displacement* of a vessel is the weight, in tons of 2,240 pounds, of the vessel and its contents. Displacement "light" is the weight of the vessel without stores, bunker fuel, or cargo. Displacement "loaded" is the weight of the vessel, plus cargo, fuel, and stores.

For a modern freight steamer the following relative tonnage figures would ordinarily be approximately correct:

Net tonnage (B. R. T. net)	4,000
Gross tonnage (B. R. T. gr.)	6,000
Dead-weight carrying capacity (D. W. T.)	10,000
Displacement loaded, about (T. D.)	13,350

A vessel's registered tonnage, whether gross or net, is practically the same under the American rules and the British rules. When measured according to the Panama or Suez tonnage rules most vessels have larger gross and net tonnages than when measured by British or American national rules.[5]

Increased Profits through Prevention of Damage

Increased profits are possible through the prevention of damage. Not alone will profits be increased by economy through skillful stowing, or through quick dispatch in port, but also through skillful loading of the vessel to prevent loss by damage to the ship, by damage to the cargo, by injuries to the crew, and by realizing a minimum insurance rate. Carelessness or lack of skill in loading may lead to claims for damages on the part of the shipper, or may even endanger the very existence of the ship itself.

Prevention of Damage to the Ship or Injury to Crew.— Failure to place the cargo properly may result in strain or injury to the vessel, or perhaps in total loss. If the weight is too low the ship will roll badly; if too high it may capsize; if distributed unevenly along the keel the vessel will be out of trim; and if there is excessive weight on one side a list will be given. Unless the cargo is well secured, shifting will occur, with resultant strain and breakage. Moreover, some cargo, because of its very character, will injure the vessel. Acids will corrode metal parts, oils will discolor woodwork and make it inflammable, fertilizers will leave obnoxious odors, and other kinds of goods will have equally serious effects.

A large number of vessels are wrecked each year because of poor stowage and dangerous cargoes. Members of the crew are injured or lost for the same reasons. More careful work would result in the saving of many lives and thousands of dollars.

[5] Prepared for the United States Shipping Board by Dr. Emory R. Johnson.

Prevention of Damage to the Cargo.—Cargo should be protected against various sources of damage, such as moisture, heat, vermin, chafe, and theft. The profits of a voyage may be absorbed by damage claims, unless stowage is carefully carried out. Losses most frequently fall upon the insurance underwriters, but the shipowner is liable if negligence is shown. It is probable that a larger percentage of cargo has been damaged in transit during the last few years than ever before. Shipowners have grown careless and longshoremen doubly careless. Remedial measures require concerted and forceful action.

Saving through Reduced Insurance Rates and Depreciation Charges.—The shipowner does not have to bear the high insurance rates against damage or theft of cargo, but a large portion of his gross income is paid for insurance and depreciation on his vessel. The insurance charges will be reduced for him if he can place his vessel in a higher class or if the whole level of rates is lowered. The level will be lowered only as losses become less frequent. Each shipowner therefore plays a part in fixing his own rate, even though he often feels that he has no hand in the matter. There is a closer relation between his action and the depreciation rate.

Of course, depreciation depends upon other factors than stowage, but it is evident that careless stowage leads to rapid depreciation and therefore to high depreciation charges. Care in stowage will, in the long run, result in great economy.

This introductory summary of factors entering into the responsibility of the wharf superintendent and his staff in making a steamship company a losing or a profitable business enterprise should be kept firmly in mind throughout the following pages.

CHAPTER II

FROM LAND TO WATER CARRIER[1]

Loading and Unloading

The wharf superintendent, his staff, and his equipment exist to the end that ships may be loaded and unloaded; they must be loaded from the land and must discharge cargo to the land.

Before passing to the details of the problem it will be well to review in a general way the various types of cargo and carrier which the wharf must accommodate.

Movement of Cargo by Lighters.—In ports where there is insufficient depth of water at the wharves or along the shore the freight must be moved between ship and shore by means of other vessels. At many of the ports in the world the larger vessels cannot come up to the shore at all and must remain anchored "in stream" if the port is a river port, or in the open roadstead of the bay. This is true at Shanghai, for instance, where the chests of tea are loaded from the shore into a small junk that can come up to the shallow-water wharves. The junk goes out to the ship, which is anchored down the river, and the tea is loaded from the junk overside into the seagoing ship in the open roadstead.

A notable example of lighterage service in loading and unloading ships and bringing the cargo to and from the ship and the shore is to be found on the west coast of South America. In most of the west-coast ports the ships anchor in the open roadstead and discharge their freight onto lighters. The difficulties of building permanent wharves are very great and would cost more than the volume of the traffic could bear. It is more economical to lighter a small volume of freight per annum than to expend large sums in permanent works.

Where there is a sufficient volume of freight to justify the capital investment in constructing permanent and solid landing places this is done. Therefore, by necessity, lighters may be used to "lighten"

[1] By R. S. MacElwee.

a ship or, in the case of a small movement of cargo which will not make it pay to build expensive facilities, the lighter is used by choice.

Grain.—The smaller vessels or lighters may be used by preference in well-equipped harbors. For instance, it is usually more economical to move a part of a cargo of grain to a ship taking on or discharging miscellaneous freight at a wharf than it is to move the ship to the grain elevator. Therefore, in all great harbors where there is a considerable movement of grain, there are to be found high-power pneumatic or other mechanical floating grain elevators that come alongside the ship to discharge or load grain from lighters or barges.

Bunker Coal.—Where a collier is loading a full cargo of coal, it is more economical to bring the coal to the ship for bunkering purposes than it is to have the ship go to the coal pile.

Heavy Articles.—Very heavy articles are loaded overside from lighters by preference. Usually the wharves are too congested with small articles to give maneuvering space and are not equipped with cranes to handle goods in cases or packages that are too heavy to be handled by the ship's booms and deck winches. In such cases it is more economical to pick up the heavy packages at the point of origin in the harbor and place them on a lighter by means of a floating derrick with large lifting capacity. One derrick remains alongside the hatch to put the heavy packages from the lighter into the ship. The lighters are loaded by either stationary or floating derricks at the point of origin in the harbor. In the best-equipped ports articles of two or more tons are loaded from lighters and floating derricks.

Dangerous Cargo.—Dangerous cargo is usually loaded from lighters to a ship anchored some distance from the shore. During the World War most of the ammunition, TNT, cartridges, shells, etc., for the A.E.F., was loaded into ships lying at anchor at Gravesend Bay.

River and Canal Barges.—When a ship discharges or takes most of its cargo to or from river and canal barges, there is no need of expensive wharf construction, because the ship can discharge directly overside into these canal barges or take its cargo from them. In fact, certain great ports, in particular the port of Rotterdam, have long rows of mooring posts or dolphins to which ships tie and lade or unlade directly overside from river and canal barges.

Direct Connection by Wharves.—In all the important ports of the world and many of the small ones ocean-going ships tie up to

a permanent structure. In our American vernacular we call it a "dock." However, a dock is an artificial basin of water usually separated from fluctuations in the water level by means of water gates. A dry-dock is such a basin that is capable of being pumped out and made dry. Unless it is perfectly obvious what is meant, it is confusing to call the wharf structure a dock. The technical name for the permanent structure to which a ship ties to discharge or take on cargo is a *wharf*. This wharf may be either of pile construction or masonry and fill, or a combination of the two. Piers are wharves that extend into the roadstead or fairway from the shore line. At New York the piers are of pile construction, but at other ports, particularly the new piers at Philadelphia, Norfolk, and Seattle, they are a combination of pile and solid-fill construction.

Quay is the European term for wharf and generally means a solid masonry wharf, the masonry wall usually mounted on piling cut off at low water and tied back by stringers into solid ground so that the weight of the shore will not push the wall out into the water. The quay structure is usually understood to be a long bulkhead parallel to the shore, in contradistinction to the pier that extends out into the water more or less at right angles to the shore line. The wharves that border the artificially excavated basins in the great European ports are almost always called quays. Therefore, the word quay has come to be associated in the mind with this type of structure and will be used hereafter to denote a wharf along the bank or shore line or, more correctly, the bulkhead line.

A *quay system* in wharf-planning means something more than a masonry bulkhead wall. The characteristic of the water-front plan behind a quay wall is the arrangement of railroad car tracks, transit shed, marginal street, and warehouses parallel with the quay wall and with the ship at its berth. This enables cargo to move away from each hatch at right angles to the ship without interfering with work going on at other hatches. A huge solid-fill quay pier of considerable length, 2,000 to 5,000 feet, with a width of 500 to 700 feet, yet exhibiting the characteristic of freight contact with the ship at right angles, is a quay system. For all purposes such a pier is two quays back to back. Authorities are in agreement that the quay system is more efficient than the New York pier system wherever physical conditions permit its operation.

For consideration here it is immaterial whether the structure is a wharf, a pier, or a quay, so long as it is a well-constructed and well-equipped place for the lading and unlading of ships.

The structure of the wharf from the engineering standpoint [2] and the efficient layout and design [3] of the same to insure the greatest facility of loading and unloading and the handling of the freight across it are too complicated to be entered into here. However, the questions of wharf structure, design, and equipment are of the greatest importance and are not to be treated casually in connection with the other problems in this study.

Wharf Equipment.—Under "wharf equipment" may be understood the transit sheds, the presence or absence of railway tracks on the wharf, the usual cargo-handling machinery, such as cargo masts, winches, cranes of various kinds, telphers, or overhead trolleys, electric trailer trucks, horizontal and elevating conveyors, both electric and gravity, stacking and tiering machinery, specialized equipment, and all of the many other devices that have been developed in recent years and are being perfected and added to from time to time.

Therefore, a ship entering a harbor may by necessity or by choice establish indirect connections with the land by means of lighter or river barges, or if the facilities are afforded may proceed to a wharf for direct loading or discharging of cargo.

The manner of this loading or discharging, either "in stream" or at the wharf is largely dependent upon the nature and construction of the carrier itself, as well as upon the nature of the cargo. The nature of the cargo often determincs the type of ship and wharf.

Kinds of Cargo

The kind of cargo is most important in determining the type of cargo carrier and the machinery for loading and unloading the same. The type of cargo is the main consideration in determining the methods of storing it at various points in its movement. There is bulk cargo, both solid and liquid; there are uniform packages, such as bags, bales, bananas, etc.; and there is general cargo, made up of all kinds of freight in packages, boxes, cases, and containers of

[2] *See* Carlton Green, *Wharves and Piers.* McGraw-Hill Book Co., 1915.
[3] *See* R. S. MacElwee, *Ports and Terminal Facilities.* McGraw-Hill Book Co., 1918.

irregular size and weight. These three distinct classes of cargo are determined according to the nature of container or lack of container for the merchandise. Also, there is cargo of extremely high value, such as gold and silver bullion. These different classes must be kept in mind, as both carriers and port facilities should be designed according to the nature of the cargo handled. In addition, there may be considered other characteristics of the cargo, such as the danger of fire and explosion.

Bulk Cargo.—Bulk cargo in general means all commodities not shipped in containers.

Grain.—Hard grain, such as wheat, rye, barley, rice, and sometimes oats, are usually shipped in bulk. Grain lends itself to handling and transfer by gravity flow or pumping by pneumatic elevators, and also by mechanical conveyors of the chain-bucket and even the grab-bucket variety. It is moved horizontally by belt conveyors. Grain in bulk requires special equipment for economic handling. Wheat in bulk can be handled very cheaply, but if converted into flour and shipped in barrels or sacks it becomes package freight and is handled by manual labor a pinch at a time. The holds of most ocean vessels are made tight so that they can carry grain pumped into the holds in bulk. Grain shipping has its own peculiar considerations, such as conditioning, elevating, stowing for safety to itself and to the vessel, and other considerations that will come out from time to time in the discussion of stowage. Grain is an important cargo for passenger liners, particularly to fill "distress room" when other cargo has not been booked in sufficient quantity. When grain is shipped in bags it ceases to be a bulk commodity and is handled as any similar package freight.

Ore and Coal.—Ore and coal constitute a large percentage of bulk cargoes. These commodities are usually loaded by gravity chutes from pockets and unloaded by clam-shell grab buckets or chain-bucket conveyors. Equipment for handling coal, ore, lime, sand, and gravel, is of special construction in each case. The loading and discharging of ore and coal has reached a high state of development in the United States, particularly on the Great Lakes. The movement of these commodities in bulk has become so specialized that distinctive types of vessels and wharves have been designed for this service. Wherever these bulk commodities are handled by regular ocean-going vessels, either as part or all of their

cargo, their loading and discharge become a part of the duties of the wharf superintendent or chief stevedore.

Liquid Cargo.—To this group primarily belong petroleum and petroleum products, from crude oil to naphtha, lubricating oil to some extent, although this is usually shipped in containers, and vegetable oils to an increasing extent. Prerequisites in the handling of liquids in bulk are tank vessels, tank cars, pipe lines, and the pumping machinery to load and to unload at equipped wharves or by means of tank lighters. The growth in the use of fuel oil under boilers and for internal-combustion engines of the Diesel type is increasing oil shipments to various tank stations throughout the world. One interesting development may be cited. It is usual for trans-Pacific ships from the United States to carry sufficient fuel oil for the round trip. Oil-burning ships going to the Orient utilize the tanks made empty on the outward voyage to carry bean oil in bulk as cargo on the homeward voyage. The carrying of liquids in bulk is increasing. Even molasses may be carried in this way. The stevedoring problems involved are very simple, as the entire transfer from ship to shore is by means of pumping machinery and special equipment.

Ships' Supplies.—Bunkering of a ship with coal or fuel oil and putting on board the necessary supplies of lubricating oil and water are of particular interest to the wharf superintendent. Unless a ship is carrying these articles as cargo, it is usually much cheaper to bring them to the ship at her wharf than to move the ship to the supply station. She is usually breasted off from the wharf a sufficient distance to enable coal, oil, or water lighters to come along both sides and to go about their work without interfering with cargo loading. Supplying the ship is bulk-commodity handling *en détail* rather than *en gros*, although large quantities are sometimes required.

Uniform Package Freight.—Analysis of the containers used will disclose that large amounts of freight are shipped in "uniform containers." By this we mean barrels, kegs, boxes, bags, and crates of a uniform size, such as crates of oranges, lemons, apples, and other fruit, crates of canned goods, bananas in bunches, and many other commodities in packages running fairly uniform as to size and weight. Bales of cotton are another example of uniform freight. Distinction is drawn between the uniform container and the package that may be of a size to hold anything from a phono-

graph to a locomotive. Wherever there is a large percentage of uniform freight it may be worth while to put in special machinery for handling it. This has been done at the cotton warehouses in Galveston, New Orleans, Mobile, and Manchester, England. Banana ships are unloaded by specially constructed banana conveyors and unloaders at New Orleans. The problem in recent years has been attacked with full energy, and new developments in specialized machinery are now appearing on the market.

General Cargo.—Although general cargo does not comprise the greatest tonnage of all the commodities carried in the world, it is by far the more valuable. For instance, although the great ore, grain, and coal movements through the Soo Canal are almost as large in a single month as the general-cargo movements through the Suez Canal in a year, the value per ton is obviously far greater at Suez. General cargo makes up the large amount of the commerce of the world as we understand it. It is with general cargo primarily that the steamship lines, and to a large extent the tramp ship, are concerned. General cargo may include some bulk shipments; it includes a large portion of uniform packages and, in addition, all those various crates and boxes that are familiar to our sight along the wharves of the world's ports. General cargo may also include dangerous and precious cargo. It is the lading and unlading, the handling, the warehousing, the stowing of general cargo that is the principal object of the study and concern of marine shipping.

General cargo, so far as handling in our American ports is concerned, is divided roughly into two classes according to the weight of the package to be handled. Shipping companies agree to load, as part of their duties as carriers, all pacakages of more than 2,000 pounds weight, that are brought alongside. When packages are of a greater weight than 2,000 pounds each, in many cases it becomes necessary to have special equipment, and the steamship companies are not inclined to consider the handling of these large packages as included in the freight rate. Although the modern cargo masts of newer ocean ships are capable of lifting packages of more than 10,000 pounds in weight, in most cases it is expedient to use special facilities. Under most favorable conditions the large package requires more time and labor to load and stow. Where it is possible to set a railroad car on tracks within reach of the ship's tackle, such large

packages may be lifted aboard from a gondola or flat car on the wharf side. However, whenever there are many packages of much above two tons each it is more economical and more expedient to float them alongside the vessel from the water side and to use a floating derrick to put them aboard. This equipment for handling heavy freight is in a sense analogous to the equipment for handling grain or coal, since it is special equipment and gives water-side delivery. All such miscellaneous parcels, large and small, go to make up the cargo of a modern steamship and tax the ingenuity of the stevedore. From the outset it is well to remember that general cargo is divided roughly into light packages and heavy packages.

Dangerous Cargo.—Dangerous cargo belongs either to the general or to bulk-cargo categories. The determining feature is not the container or the size of the package, but the inherent quality of the commodity. The question of shipping dangerous cargo was peculiarly important during the World War when the United States was making delivery to the Allies of TNT, gunpowder, cartridges, shells and other explosives. The terrific blow-up at the Longtown Pier in New Jersey that wrecked all the window glass in lower Manhattan Island is one example of how dangerous cargo may act on certain occasions. Petroleum, cargo coal, cotton, acids, rags, and many other commodities are considered dangerous cargo. Precautions must be taken to safeguard the ship, its burden, and its crew. The quality of the cargo, therefore, in this study will receive considerable attention, as the wharf superintendent and his chief stevedore must be constantly on the alert as regards the nature of the cargo in its relation to all the factors of stowage.

Precious Cargo.—Precious cargo is a subdivision of general cargo. In precious cargo we have shipments of goods of very high value, in particular shipments of gold and silver and other precious metals and precious stones. The mails are precious cargo. The transmarine shipment of precious metals takes a very important place in international commerce. Before international exchange and credits were entirely upset by the World War, gold shipments were made by the principal commercial nations to balance payment. It required particular handling and safeguarding on the wharf, while being loaded, and aboard the ship, adding much to the care and responsibility of the pier superintendent and his force.

Types of Carriers

The nature of the cargo exerts the dominating influence on the types of carrier and the cargo transfer, handling, and stowage facilities. The tendency toward special designs for special cargoes and trades is marked, and specialization of equipment afloat and ashore should be increased. At present there are two main groupings of carriers from the cargo transfer and handling standpoint: (1) side port, and (2) deck-hatch—the horizontal and the vertical transfer systems.

Side-port Vessels.—Side ports for loading and unloading characterizes one class of vessels. This class is composed principally of coastwise, lake and river vessels, and covered lighters; also some types of river barges. Coastwise, river, and lake passenger vessels have passenger accommodations almost the entire length of the ship, and the only point of entrance for cargo is through the side ports. Side-port transfer necessitates a horizontal movement for all deck loads. If goods are loaded from the decks into the holds it must be done within the ship.

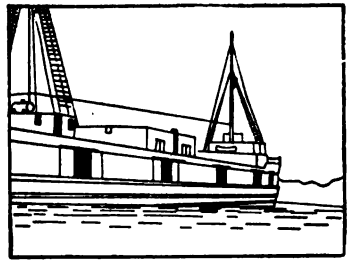

FIG. 1.—SIDE PORTS. A Great Lakes package freight steamer.

Even if lake and coastwise vessels are not constructed for passenger accommodation, the main deck of the vessel is covered from stem and stern and they are loaded through side ports just the same as their more luxurious sisters, the passenger liners. The transit movement is by necessity a horizontal one. Side-port vessels are usually loaded by longshoremen trucking the cargo across a gangplank from the wharf to the main deck of the vessel.

Hatch Vessels.—Deck hatches characterize ocean-going vessels which are loaded vertically. The usual cargo carrier has four or five hatches. Cargo is hoisted vertically, swung sidewise across the deck, and lowered vertically. Instead of the longshoremen walking from the ship to the shore with their load and back again empty, there are three gangs: one in the hold, one on the deck working the winches, and one on the wharf. The entire operation of hatch loading and stowing is fundamentally different from that of side-port loading.

All-hatch Vessels.—Vessels are built for particular kinds of service. One of the most important types of cargo-carrying vessels is that developed on the Great Lakes, in which the entire hull of the vessel, except a small section aft, reserved for the boilers and engine is one continuous hold divided by a few bulkheads. The hatches extend almost entirely across the vessel from rail to rail. There are sometimes as many as thirty-eight hatches over the cargo space of a single vessel. The hold is unobstructed by stanchions, as there is only one deck to support. These vessels are built to carry all materials in bulk that can be handled by gravity chutes into the ship and by grab buckets or suction elevators out of the ship, such as small, hard grain, coal, limestone, etc. Vessels of this type require special equipment for loading and unloading, and the equipment and the vessels are built to conform to a definite system. The question of stevedoring is, therefore, one almost entirely of mechanical appliances, the ideal toward which all water-front operation strives.

Ocean-going Colliers.—Ocean-going colliers and ore-carrying vessels have been developed that are somewhat similar to the lake carrier, but they have more lateral and longitudinal rigidity to be able to withstand the strain of the greater wave lengths of the high seas. This has led to the building of bulk-freight carriers specially designed for the ocean. The typical collier or the ore-carrying vessel—for instance, in the Swedish-Rotterdam ore trade—is easily distinguishable by the double rows of hoisting masts corresponding in number to at least twice the number of hatches. In principle, the typical collier, or ore-carrying sea vessel, is the same as the very efficient lake carrier, except that it carries its own handling machinery in order to discharge at any point directly overside into lighters, canal boats, or river barges.

Tank Vessels.—The tanker is another development of the specially designed bulk-cargo vessels. Tankers are similar to the all-hatch lake vessel in principle, that is, they have the large midship structure unobstructed and the machinery and the navigating bridges as near stern and stem as possible. Tankers carry their own pumping machinery in order to handle their cargoes. The principal cargo carried by tankers in bulk is crude and refined petroleum, gasoline, etc. Tankers sometimes carry molasses, bean oil, and other similar liquids in bulk.

Refrigerator Ships.—Refrigerator ships may be especially built for the purpose from keel up, or they may be ordinary tramp or liner vessels fitted with refrigeration to carry meats, fresh vegetables, fruits, and other perishable commodities. Refrigerated cargoes require special handling. The refrigerator ship in outward appearance does not differ materially from the ordinary cargo vessel.

These, then, are the principal materials with which we have to deal—cargoes, wharves, and ships.

CHAPTER III

WHARF OFFICE ORGANIZATION[1]

The General Wharf Superintendent.—The general wharf superintendent is in charge of all the piers and has every pier activity, even to the smallest detail, always at his command. His experience must be such that whenever he walks through the piers, which he does once or twice a day, he can tell at a glance whether all the activities are moving along as smoothly as they should. He is supplied with a clerical assistant, who is a stenographer and attends to the office routine work, which is practically the same as the work in any commercial office.

The Pier Superintendent.—The general superintendent has under him a pier superintendent for each pier, whose duty it is to superintend everything pertaining to the handling of cargo from the time it is accepted by the delivery clerk from the owner or shipper until it is properly stowed in the ship, or from the time the cargo is taken from the ship and delivered to the owner or consignee, baggage included. The pier superintendent must at all times keep in close touch with each progressive step, in order to give any information at any time when called upon by the general wharf superintendent or the head office. It is his duty to adjust all minor misunderstandings that may occur on his pier, unless he feels the trouble is beyond his jurisdiction.

The Stowage Clerk.—The stowage clerk, usually located in the office of the pier superintendent, sees that the cargo is stowed in accordance with the stowage plan, which has been previously prepared by the general manager after consulting the ship's captain. The stowage clerk copies this stowage plan on a profile chart and makes two additional copies, one to go with the ship and one to be sent to the clearance office of the customhouse. The first chart made out is retained by the general wharf superintendent.

[1] This chapter is taken largely from MacElwee, "Training for the Steamship Business." Miscellaneous Series No. 98, Bureau of Foreign and Domestic Commerce, Washington. (Sold by the Superintendent of Documents.)

The stowage clerk has another duty to perform. Some captains, by reason of their own experience in navigating the ship, want the ship loaded so that she will ride on an even keel; others may want the ship to have a drag, and still others may want her slightly down at the head. The figures on the bow and stern which indicate the ship's load draft are exactly 6 inches high and are spaced 6 inches apart. For instance, from the bottom of figure 12 to the bottom of

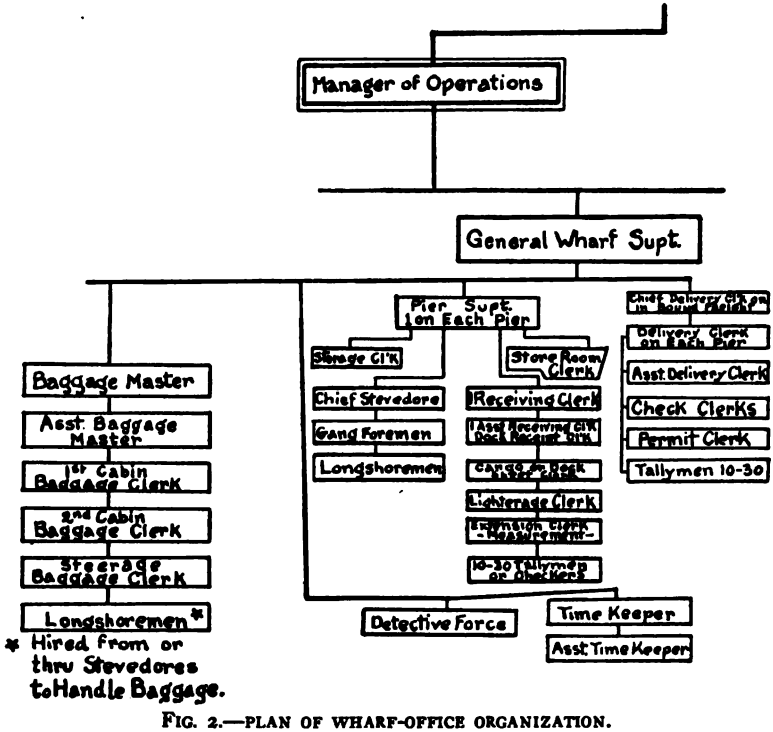

FIG. 2.—PLAN OF WHARF-OFFICE ORGANIZATION.

figure 11 is just 12 inches. Consequently, if the captain wishes his ship to have a 6-inch drag, the stowage clerk, when the ship is loaded, will see that the water line coincides with the top of a figure on the stern and is even with the bottom of the same figure on the bow. If a ship is to ride on an even keel, the water line must coincide either with the top or bottom of corresponding figures on the bow and stern. The stowage clerk, toward the end of loading, watches the marks closely and indicates to the chief stevedore that the vessel is not receiving the required trim by so and so much. In fact, the

stowage clerk frequently checks the fore-and-aft drafts during loading in order to keep the ship on an even keel until nearly loaded, when he proceeds carefully in order to have the ship ride as the captain wishes.

The Store Clerk.—The store clerk, also directly under the pier superintendent, is in charge of supplies, such as ropes, slings, falls, etc., which belong to the piers and are used in connection with the ship's gear when handling cargo. It is his duty to see that everything under his care is kept in its proper place, to keep a record of all material in his charge, order new material when needed, and dispose of all worn-out rope and slings. He gives out rope, slings, etc., to the longshoremen on checks or receipts, and is held responsible for all material not returned to him. He cuts all new rope to the proper lengths; his helpers (longshoremen as a rule) make up slings from the best part of worn rope, also splice new slings, and in general keep everything required in good shape, including the repairing of blocks, etc.

Baggage Department

Operation of this department comes under the general wharf superintendent. It consists of a *baggage master*, an *assistant baggage master*, and *baggage clerks*, according to the amount of passenger travel. All rules or instructions governing the handling of baggage are issued by the passenger department.

Baggage Master.—The baggage master is responsible for this department. It is his duty to see that the rules issued by the passenger department are carried out. On outward sailings it is the duty of the baggage master to record all baggage and see that it is properly laden aboard steamer as the passenger desires—in the stateroom, in the baggage room where passenger may have access on the voyage, or in the hold where it is not accessible until the steamer arrives at destination. On inbound steamers it is the duty of this department to see that all passengers' baggage discharged from the steamer is placed under the proper letter of the alphabet on the pier for customs examination. The labor for handling trunks on the wharf is furnished by the chief stevedore. Longshoremen are glad to get this sort of work because of the tips in addition to wages. Hand baggage and steamer trunks are handled by the ship's stewards.

The baggage department employees must be careful and courteous at all times. A passenger's comfort depends in many ways on the efficiency of this staff. It is important for the baggage department officials, especially in handling third-class and steerage passengers' baggage, to have a speaking knowledge of foreign languages, such as French, Italian, Spanish, the Scandinavian languages, German, Polish, and Russian, as well as familiarity with the value of foreign money. There is a separate baggage room for cabin passengers and for steerage passengers.

The Receiving Department

There is a head receiving clerk for each pier (at Atlantic ports this is for eastbound freight received for loading on to the ship), with a clerical staff of from two to six assistants, according to the size of the pier and the amount of cargo handled. On the larger piers the staff includes an *assistant clerk*, a *cargo-sheet clerk*, a *lighter clerk*, an *extension clerk*, and *checkers* or *tally clerks*.

The Chief Receiving Clerk.—This employee is in charge of the receipt of all goods on the pier. He hires his assistants, who are permanent employees (not day workers), and assigns them to their regular work and is responsible for the records and reports of his office. He also indicates the number of tallymen required, who are hired and assigned to him, or he may hire them himself. At the end of each loading of a ship he turns the records over to the pier superintendent. He is in line of promotion to take the position of pier superintendent, but, of course, has competition from other members of the wharf staff who are heads of other departments.

The Assistant Receiving Clerk.—The assistant receiving clerk occupies a permanent position; that is, he is not hired by the hour for the job as are tallymen and longshoremen. Usually he is not a union man and is on a straight salary basis. He is responsible for the signing of the dock receipts when goods are delivered at the pier. The dock receipt is a very important *ad interim* document. The receiving clerk must come up through the other ranks in order to receive that training in routine detail which will enable him easily to detect mistakes and serious errors when they come over his desk. Through experience as tallyman and clerk he acquires a knowledge

of packages and freight as to size, weight, and many other details, that enables him to recognize a mistake at a glance. He is in charge of the detail work of the receiving office. He directs the activities of the lighter, stowage, and tally clerks, changing them from point to point in accordance with the demands of loading and unloading the cargo, or when handling cargo on the pier. He checks all records and reports.

Hours of Work.—The receiving clerks, delivery clerks and their assistants, time keepers and assistants, baggage masters and assistants, all work eight hours a day, 8 A.M. to 5 P.M., with one hour for lunch. They get time and a half for all overtime, and double time for Sundays and holidays. In May, 1919, according to the president of the Steamship Clerks' Association, there was no standard pay for these clerks, the salary ranging from $36 per week as a minimum to $50 maximum.

The Cargo-sheet Clerk.—The position of a cargo-sheet clerk is an advancement over the extension and lighterage clerks. He is responsible for making up the dock list or cargo sheet from the stubs of the dock receipts that are given to the truckmen who deliver the goods and from the tally sheets handed to him by the extension clerk and the lighterage clerk. The cargo-sheet clerk is responsible for the correct entering on the cargo sheets of all necessary information required before the vessel leaves the pier. It should be borne in mind that this work must be absolutely accurate and also done with dispatch, because the ship, when loading, receives its cargo rapidly and must not be delayed because of the lack of data that cargo clerks get together to make the manifest. The manifest must be sworn to and delivered at the customhouse as a true account of amount, kind, and destination of articles of cargo before the ship can be cleared. ("Dock sheets" of receiving clerks' returns should not be confused with "cargo books," which are made for use of ship's officer only.)

The Lighter Clerk.—Another tallyman promoted to full time and permanent pay in the receiving office is the lighterage clerk. He receives the lighterage manifest and from it makes up the data that goes into the ship's manifest. He makes a dock sheet for this purpose. Through tallymen he keeps tally of all cargo loaded into the ship from a lighter. He keeps a record of the number of pieces of cargo, the number and mark on each piece, the weight and measurement, the number of the hold, and the deck in the hold in which it

is stowed. Some companies require him to get this data from the lighter and others from the deck of the ship.

The Extension Clerk.—The tally sheets from the tallymen go to the extension clerk in the receiving office on the pier. The duty of the extension clerk is to convert all straight measurements of the various pieces of cargo into cubic measurements. The position of extension clerk is a promotion from that of tallyman. He is a union man and to all intents and purposes a tallyman, but works full time. Although receiving the same wage, he is not laid off on slack days at the pier. The extension clerk, by means of conversion or cubical measurement tables, converts the weights and measurements on the tally slips to weight tons or 40 cubic feet, and consolidates the report ready for the calculation of freight in the preparation of the dock sheets from which is made the ship's manifest in the main office. A case may measure 4 by 4 by 10 feet. This is 160 cubic feet or 4 measurement tons. The case may weigh only 2½ tons, but the extension clerk marks down the "tonnage" on which the ship receives the greatest return. Freight charges are based on these records.

Tallymen or Checkers.—At the bottom of the list of clerks are *tallymen*, sometimes called "tally clerks" or "checkers," who constitute the foundation of the clerical force on the pier. A large pier will employ from ten to thirty tallymen in each department for incoming and for outgoing freight. They count and measure packages delivered to the wharf for shipment, and note any damaged or unusual condition of the package. They also check or tally the cargo discharged from vessels. Their reports are made on tally sheets. Tallymen are usually union men. They are paid by the hour on an eight-hour day basis, but in the interest of efficiency as many as possible are kept in steady employment on the piers.

The working hours for checkers (May, 1919), or tally clerks, are from 8 A.M. to 5 P.M., with an hour for lunch, six days a week, for which they receive $5 a day. If they work before 8 A.M., or after 5 P.M., they receive $1 an hour for such service. For Sundays and holidays they receive $8, whether they work one or eight hours.[2]

Tallymen may be advanced to more responsible and permanent positions, but they are always paid on the time basis until they

[2] The above figures were obtained from the business agent and secretary of the Checkers' Union, Local 874, New York, N. Y.

become assistant chiefs or chiefs of a department. Tallymen should have a good common-school education or preferably a high-school education. They are usually taken on when about eighteen years old, but there is no reason why a college graduate should not begin as a tallyman in the shipping business. A young man taking this position should have a good handwriting and be good in arithmetic, as much of the work is measuring dimensions of cargo. The position is one of the best openings for a man to learn the shipping business from the ground up. The vice president of a great company, who himself, at sixteen, started as an apprentice in a shipping office, stated that there is no place in the shipping business where a man can learn as much about it in the same length of time as in the position of tallyman.

The Stevedore

The stevedore is the man who is directly responsible for the loading and stowing of a ship or for discharging its cargo. The stevedore's gang for each hatch unloading usually consists of 23 *longshoremen*, 6 "in the hold," 5 *sailormen* on deck and 12 men on the pier. These three groups or gangs are under one *stevedore foreman*, or sometimes there is one foreman for the forward hatches and another foreman for the after hatches. Longshoreman work is primarily manual labor, although much skill is developed, particularly by those who handle the deck winches that run the fall ropes. The stevedore is the executive. It is much the same relation as that existing between masons and carpenters and the contractor. Stowing in the hold requires experience and skill.[3]

The Chief or Boss Stevedore.—The chief or boss stevedore of a pier is an important person. He usually rises from the ranks of the longshoremen. He learns by experience how a ship can be loaded and in time acquires knowledge of the various ships of the line and their peculiarities. Ships have their own individuality and do not carry their loads alike. He is assisted by the ship's officers, who also acquire an intimate knowledge of how a cargo can best be stowed on their own particular vessel. The ship must be loaded to capacity so as to avoid waste of carrying space, and yet it must not be loaded below the safe-load line or in such manner as to strain

[3] *See* Chapter IV, page 55; *also* Barnes, *The Longshoremen*, pp. 51-54.

hull or expose cargo to damage. Furthermore, certain kinds of cargo are prohibited by law and certain other kinds may be carried only in a manner specified by law. A thoroughly competent chief stevedore is of such importance that he is seldom promoted to be pier superintendent, it being more advantageous to keep him on the job and increase his pay. A longshoreman or a boss stevedore may save some capital and become a contracting stevedore, but this has lately become more difficult, as an increased number of steamship lines do their stevedoring under their own salaried chief stevedore instead of letting it out on contracts.

Longshoremen.—Longshoremen [4] are usually union men. They work by the hour. Formerly a gang could load 250 tons a day, but now the efficiency of the longshoremen has decreased until a gang will load less than half this amount. Wages have about doubled, making a 400 per cent increase in the cost per ton of loading and discharging vessels. As in other industries, the only remedy is to increase the output of the worker by mechanical inventions. "Labor-saving machinery" is simply an expression for mechanical devices that will enable one longshoreman to handle many more tons of freight in eight hours.

The Timekeeper.—Each pier has a timekeeper and an assistant timekeeper. Sometimes a tallyman is assigned as a third member of this force. On some piers the timekeeper force is a large one; on others two or three on each pier are considered sufficient. The qualification for this position is primarily a memory for faces and names. The timekeeper checks the time that the men enter and leave the pier. Some lines use a time clock, but on some large piers full reliance is placed on the timekeeper's quick eye and memory. It requires a clear head to be a timekeeper, as he has to charge labor time against forty-eight different items (in the cost accounting of the company here cited). The timekeeper also makes reports on accidents. The performance of the duties of this position involves considerable exposure at drafty pier entrances, summer and winter, but as it is almost entirely an open-air job, it offers this advantage to those who do not like to work inside. The timekeeper makes up the pay envelopes for the men and is responsible for the pay of the pier force. A tallyman is often assigned to full-time duty as assistant timekeeper and is in line for promotion to timekeeper.

[4] *See* Chapter IV, page 55; *also* Barnes, *The Longshoremen.*

The Delivery Department

The delivery department has charge of incoming freight. (At Atlantic ports this is westbound freight.) For each group of piers there is a *chief delivery clerk*, who has under him a delivery clerk on each pier. Beginning at the bottom are tallymen, who belong to the same union as those of the receiving department. The force of tallymen is the same and may be employed by either department. The tallymen check the goods as they come from the ship on to the pier and make out checking slips in such a manner that it is possible at the office to see what cargo on the manifest has been received. Errors of excess or deficiency are detected in this way and brought to the attention of the delivery clerk, who is responsible for the notation of any pilfering or damaged packages.

Aside from the tallymen, the office force of the inbound freight department consists of a delivery clerk, one or two assistant delivery clerks, clearance clerk, and customhouse clerks, who handle the several operations of inbound freight routine.

While the ship is at sea the cargo-discharging receipt book is made up by the purser from the ship's manifest. When the goods are landed from the vessel and made ready for delivery they are checked by the tallymen according to marks and numbers on tally slips and stamped by the customs inspector to show that the necessary request for landing permit has been lodged. The tally slips are sent to the delivery office and if everything is in order, freight paid, etc., receipts are taken and delivery effected. The cargo book goes to the receiving office on the pier; the bills of lading go to the customhouse and are entered there; and a permit to take the goods from the pier is issued. When the goods are taken from the pier an entry to that effect is made in the cargo book. When 10 per cent of the goods go to the customs appraisers' stores for valuation, they must be accounted for and the necessary entry made and papers issued to cover this merchandise. The clearance clerk is entrusted with the issuing of the proper notices and the checking of delivery of shipments to the consignee. In addition, the members of his force must make out *lien notices* on the freight, and after five days prepare *removal notices* directing removal of goods within forty-eight hours. If they are not removed they go to warehouses "at the cost of the merchandise," for which the proper papers and receipts

must be made out. There are also *general order store notices*, *damaged cargo special reports*, *claim reports*, and many other forms that must be rapidly and carefully handled by this force and checked by the chief clerk in charge. The inbound or delivery department on the pier is complicated because of the customs formalities. Damage or loss is usually detected at the time of landing and delivery of the merchandise to the consignee rather than when it is loaded. This puts most of the work for claims and adjustments on the receiving staff.

The Detective Force

Under the wharf superintendent on every pier is a private detective force maintained by the company or furnished by an agency under contract. The paper work in connection with service will be discussed in a later chapter. These detectives, like those in department stores, are primarily interested in preventing pilfering; they become expert in noticing any package that has been tampered with and in diagnosing other causes of damage to cargo. The judgment of an experienced pier detective is valuable in the adjustment of all kinds of insurance claims as well as in the protection of the cargo.

There is a *chief detective* with several assistants on each pier. They are private detectives—a part of the wharf force. When a ship is being loaded an assistant detective is placed in each hold, while others are stationed at advantageous points on the pier to keep a watchful eye on all activities.

This survey of the wharf organization is given here to serve in orienting the newcomer, as was the purpose of the preceding chapters. Details of the various duties and departments are discussed in succeeding chapters.

CHAPTER IV

THE LONGSHOREMEN[1]

Longshoremen and the Importance of Their Work.—The general public has only within the last year or two become aware of the meaning of the term "longshoremen" and the importance of the longshoreman's work. The aid given by the longshoremen in dispatching supplies to France, the competition between the different stevedore units at the base ports abroad, and the succession of longshore labor troubles and strikes in this and other countries have all helped us to recognize that a longshoreman is one who loads or unloads ships. This, however, is not an exact definition. He must be distinguished from the stevedore, who is his superintendent—or employer; from members of the crew who no longer assist in the loading operations; and from the dock workers and other laborers along the water front. The National Adjustment Commission has defined a longshoreman as "one who carries cargo to the hatch or to the ship's side," but this definition is not broad enough, for longshoremen also work on the deck and in the hold of the vessel. Any laborer who is employed for the purpose of loading or discharging ship's cargo is a longshoreman.

There are perhaps 90,000 men in the United States who may properly be classed as longshoremen, and there are many more who occasionally engage in longshore work. These few men handle millions of tons of domestic freight and over 90,000,000 tons of foreign freight every year; they are responsible for the safety of more than ten billion dollars' worth of exports and imports; and yet they are an isolated and unknown group of our society. There is only one book about them and the author of that states that "the most conspicuous fact concerning the longshoreman is his inconspicuousness. Libraries, statistical reports, labor histories almost without exception ignore him or misstate his case." [2]

[1] By Thomas R. Taylor.
[2] Barnes, *The Longshoremen.*

Nationality and Skill.—The group is made up very largely at the present time, and especially along the Atlantic seaboard, of Irish, Negroes, and southern Europeans. Negro longshoremen are common from Galveston to Baltimore, and they flocked to Philadelphia and New York in large numbers when the World War cut off the immigration of unskilled labor. At New York, the Irish were employed almost exclusively until about 1887, when there was a great influx of Italians. Since then, men of other races, especially Jews and Slavs, have entered the industry and the average gang at present is a mixture of almost all races. Negroes are ordinarily placed in groups by themselves, but it is not uncommon to see them in holds working with Germans, Greeks, Jews, Italians, Austrians, Syrians, and others. Irish or Americans are still preferred, for they are stronger on the average, are less subject to disease, and keep their head in emergencies and in the flood of Bolshevist literature which has recently swept its flotsam of trash into the ears of the gullible Negroes and southern Europeans.

It will be seen that, with the exception of the Irish, the longshore group is composed largely of the cheap, unskilled type of labor. The reason for this is the casual nature of the work rather than the scale of wages or the degree of skill required. The longshoreman can never be sure of steady employment, because the amount of available work depends altogether upon the number of ships in port and this is subject to great fluctuations from day to day or from season to season. The individual longshoreman who is familiar perhaps with the opportunities for work in only one part of the port, in which part there may be much greater variation than shown for the port as a whole, feels these fluctuations greatly. This is well illustrated in New York where there are great distances between different sections of the port. The longshoreman, working in the Chelsea section, is not in touch with the opportunities for work in Hoboken or Brooklyn, and the steadiness of his employment depends almost altogether on the number of ships loading and discharging at the Chelsea piers. Under conditions such as these it is difficult to attract the better class of laborers who prefer permanent employment even if the daily wage is less. Consequently the longshoremen's trade has been left largely to the casual, unskilled type. This condition will undoubtedly continue as long as there is lack of permanency about the work, and as long as other factors, such as

the dangerous nature of the occupation, emphasize the relative undesirability of the trade.

Classification according to Skill.—The building up of a skilled personnel is made difficult also by the variation in the character of the work of the individual longshoremen. Manual skill is developed by constant repetition of one movement or one set of movements, and the average longshoreman does not have the opportunity for such repetition. He works on different piers and ships, with different commodities, and at different operations. Almost every day, or even every hour, his work changes. He is forced to be a Jack-of-all-trades. There are, however, certain chances for specialization, and these have afforded several bases of classification of longshoremen according to their skill. There is first the classification of skill according to the class of trade of the ship being worked. The "deep-sea" longshoremen, who load and discharge the cargoes of ships in the foreign trade, must do their work more carefully than those working on a coastwise vessel, and they stand on a higher plane and receive higher wages than the coastwise worker. The coastwise worker in turn ranks higher than the man who handles the cargoes of harbor craft and to whom the term "shenanago" is derisively applied.

Classification according to Trade.—There can be made a second classification based on the commodity handled. No skill or dexterity is required in the handling of some commodities, and any man picked up off the streets can learn his duties in a few minutes. The unloading of bananas is an excellent illustration of this, for this work consists simply of passing bunches of bananas along a chain of men. These men are considered professionally and socially inferior to those who work on commodities that are more difficult to transfer or stow. The loading or discharging of lumber, grain, coal, explosives, oil, barreled materials, and of some other commodities requires the exercise of qualities not possessed or developed by the "banana fiend," and it is in the handling of these commodities that we find longshoremen who may be properly considered skilled specialists. A grain trimmer, for example, may become so adept that he is in great demand and will refuse to work on anything but grain. The great mass of longshoremen, however, handle general cargo or bulk cargo indiscriminately and make no effort to specialize.

Classification according to Actual Work Performed.—Some truck goods on the pier, others make up the slings, give signals, run the winches or falls, or stow goods in the hold. In some places there are well-defined lines between these classes. A pier man will stay a pier man until he is promoted to a higher grade, and a winchman will operate winches day after day. In such places there is opportunity for specialization. At other ports, however, there is little or no distinction, and a man shifts from one work to another.

Ways of Building Up a Skilled Personnel.—It would be advantageous to the shipowner if skilled workmen could be attracted to, or developed in, the trade, for inefficient and careless work causes delays in port and damages to cargo and ship. There are two possible ways of building up such a skilled force. One is to attract the better type of man by regularizing employment in paying the men on the monthly or weekly basis instead of by the hour or day, and this course has been taken by several steamship companies. The other method is to develop skill under the present daily wage system by hiring specialists only for all work that requires any training. A central employment agency could keep all longshoremen listed as barrel men, coal trimmers, winchmen, etc., and the stevedore or pier superintendent could call for those needed. This system has been adopted at several foreign ports but is rather consistently opposed by stevedores in this country.

Methods of Hiring Longshoremen.—The methods of hiring generally used in the United States are quite primitive. At New York the expected arrival of a vessel is heralded by the hoisting of a flag at the pier at which it will dock, and by a notice in the newspapers. Longshoremen out of work gather outside the entrance to the pier shortly before the vessel arrives or in the morning following arrival. It is customary for them to form or "shape" in a semicircle at the pier entrance. When the ship is ready to work, the stevedore or foreman takes a place within the "shape" and begins picking out men with whom he is familiar or to whom he is attracted. As each man is called out he passes by the timekeeper, gives his name and receives a numbered check. Several men are then combined into a gang, put in charge of a foreman, and sent to work. A gang may be held together only for a few hours, or it may be kept as long as there is work on that one ship or on several ships. When a man is released

he gives his check number to the timekeeper, but he does not surrender his check until he is paid at the end of the week.

This method has several modifications. At Philadelphia, for example, the men gather "at the corner" of Front and Christian Streets in the evening, and are employed for the following day. At some piers in New York men have been hired by the hundred instead of by individuals or gangs. Men are given checks of the first hundred, second hundred, or third hundred, according to their ability, and if there is a shortage of work, the men holding checks of the lowered hundreds will not be hired.

Whenever men are hired in this way employment is by the hour only. If there is a delay in the receipt of freight and therefore in the loading operations, part or all of the men will be released. Nor can the foreman always tell them when to return. They may go home for the rest of the day, seek work elsewhere, or stay near the pier entrance in the hope that they will be wanted.

To overcome this undesirable situation some companies with regular sailings have tried the method of employing men by the week or month. In some cases this has worked very satisfactorily, and it is to be hoped that more companies will find it a plan convenient to adopt.

Gang Work.—It would also be beneficial to hold the gangs intact as much as possible. A gang is a group of longshoremen working as a unit in handling cargo through one hatch. If the same men work together constantly, they will grow accustomed to one another and there will be a development of teamwork.

The size of the gang and the distribution of its members depend upon many factors, the most important of which are the kind of cargo, and whether the cargo is being loaded or discharged. In the loading of general cargo the average size of the gang is from 18 to 24 men. Approximately one-half of these will be in the hold stowing the goods; three to five will be on deck running the winches, handling the falls, and giving signals; and the remainder will be on the pier, trucking the freight to the picking-up place and making up the drafts. In the discharge of general cargo the gang is about the same size, but more men (approximately one-half of the total) are placed on the pier, trucking, sorting, and filling the consignments. In either case, however, the size will vary with the progress of the work, with the character of the ship and its transfer equip-

ment, with the nature of the cargo, and with other factors. When loading has just begun, the distances in the hold are relatively great and more men can be accommodated and are required to move and stow the goods than when the hold is nearly full. If the holds and hatches are large and the transfer equipment is adequate, more men can be placed in a gang, or two or three gangs can be worked at one hatch. Machinery to handle the goods on the pier or between the pier and the vessel will allow for a decrease in the number of men on the pier and deck. The kind of cargo, of course, has a great influence. Bulk cargo is handled so largely by machinery that the size of the loading gang may be reduced to two or three men, this being particularly true of those commodities that do not have to be trimmed or moved in any way after they are put in the hold. Other kinds of cargo, such as railroad rails, may require a large amount of labor on the pier and deck and relatively little in the hold. Still others, such as cotton which is compressed in the hold by screwing, require an exceptionally large number of men in the hold.

For these reasons it is impossible to state what is the proper size of a gang or how its members should be distributed. But it seems clear that there should be greater standardization than is found at present. Standards have been established only by those piers where the work varies but little, as where uniform package freight, such as sugar or case oil, is handled day after day. At other places there is almost no approach to standardization, and it will be found that the loading gangs of general cargo at different ports or even at adjacent piers differ greatly. It is also noticeable that few gangs work at top efficiency; there is almost always a congestion at one point and a slackening up of effort at others. If the stevedore would seriously attack the problem by keeping time study records of the speed of loading and discharging with gangs of different sizes and make-up, he would undoubtedly be surprised at the savings that could be made by standardization.

Barnes gives the following concerning the hatch gangs.

In loading, the number of men in the hold is greater than on the pier. In discharging, more men are needed on the pier. On the White Star piers, for instance, in discharging, 6 men of each hatch gang are worked in the hold, 5 to 6 on deck, and 12 on the pier. In loading, 6 of the pier men are transferred to the hold.

But from pier to pier the numbers vary. On the Brooklyn piers 14 men often constitute a hatch gang.

Speaking generally, however, one can say that there are usually from 18 to 23 men to a hatch gang. There are usually from 9 to 12 men on the pier—2 or 3 "slingers," who fasten the slings around

ORGANIZATION OF HATCH GANGS[3]

DISTRIBUTION OF MEN IN GANGS AT NINE CHELSEA PIERS

Line	Piers	Men in gang	Men working				
			On the pier		On deck	In the hold	
			Unloading	Loading		Unloading	Loading
White Star Line.....	2	23–24	12	6	5–6	6	12
Cunard Line.....	3	25–27	10–12	8–10	7	8	10–12
Red Star Line.....	1	23–24	12	6	5–6	6	12
Atlantic Transport Line..	1	20–21	11–12	7–8	4	4–6	8–10
French Line.....	1	23	12	6	5	6	12
American Line.....	1	21–23	10–12	6–8	5	6	10

DISTRIBUTION OF MEN IN GANGS AT NINE HOBOKEN PIERS

	Piers	Men in gang	Men working				
			On the pier		On deck	In the hold	
			Unloading	Loading		Unloading	Loading
Hamburg-American Line .	3	18–24	8–12	6–10	3–5	6–7	8–10
North German Lloyd Line	3	20–25	10–14	6–10	3–5	6–7	8–12
Holland America Line....	1	16–18	8–10	4–6	3–4	4	4–8
Phoenix Line	1	15–20	6–10	4–8	3–5	4–6	6–8
Scandinavian Line	1	18–22	8–10	6–8	4–5	4–6	6–10

the drafts, and the rest for trucking and tiering up; from 4 to 6 on deck—including the gangway man, winchman, drum-end man, and "hooker-on"; and, including the headers or hold foremen, 6 or 8 men in the hold.

Where the character of the cargo or restricted space on the piei necessitates high stacking—often 18 feet or even higher—additional men for tiering up are employed. In the old days when piers were small the stacks were frequently carried to the roof. But there is

[3] Barnes, *The Longshoremen*, 32, 33.

not so much need for high tiering on the large modern piers, such as those of the Chelsea Improvement.

The congestion on some of the piers is often relieved by storing cargo on the "farm." [4] One of the sights of the water front is this space thickly covered with heavy casks, bales, or logs, and with streets and narrow lanes giving access to the piers between the piles of freight.

Considerations of economy often cause the number of men employed on a particular job to be reduced below the point of safety. This is most often the case when the work is done by contracting stevedores. For instance, when only four men are employed on deck, the gangway man may have to act as hooker-on. Sometimes the same man is required to turn on the steam for a winch and to act as drum-end man.

Another practice even more dangerous, is due to the effort to economize time. When a ship is being rushed, two or even three gangs are sometimes worked in the same hatch. How inevitably either of these forms of economy invites accidents will appear as the description of the work proceeds.

There is throughout longshore work a swing and rhythm, as well as a shared responsibility. The gangs must work as a unit if the maximum amount is to be accomplished. Rhythm is attained as soon as the gangs are settled at the work.

Unions.—The irregularity of employment in the longshore industry not only has brought a relatively poor type of workman into the trade but has caused an interchange of unskilled and semi-skilled laborers with other industries. In slack periods longshoremen would go into other work, and in busy periods, men engaged in other trades, or unemployed, would drift into the ranks of the longshoremen. All of this has made it difficult for the longshoremen to establish and maintain a strong union, especially in New York, where the history of attempts to unionize shows an almost continuous succession of failures. The situation at Boston has

[4] According to tradition on the water front, the origin of this term is as follows:

Walsh Brothers, once the most important stevedores of the port, had at one time a foreman named Morris Walsh, who had been a farmer in Ireland. Among the men he became known as the "farmer." His particular work was to supervise the storing of goods on the open space in front of the piers. Men used to say: "I'm going out to work with the farmer," or "on the farm." Gradually the open space in front of any pier became known as the "farm."

always been more favorable to the longshoremen and a relatively strong local union was built up early. During the last few years, maintenance of locals at all ports, including New York, and of the national union has been rendered easier by the affiliation with the American Federation of Labor and by the scarcity of labor. Large initiation fees to the union are charged and must be paid by men who enter the trade, so that the members are now protected from the floating laborer.

The present situation is described by the Director of the Marine and Dock Industrial Relations Division, United States Shipping Board, as follows:

The International Longshoremen's Association was started on the Great Lakes some thirty years ago. It was at first restricted to men handling lumber.

At the present time the association has grown to a point where it includes in its locals every type of labor connected with the loading and unloading of ships, and extends geographically over almost the entire country. Besides the men who actually load and unload vessels, it represents marine warehouse freight handlers, grain-elevator employees, dock and marine engineers, stationary dock hoisters, marine repair men and firemen, licensed tug men, tug firemen and linemen, marine divers, helpers, tenders, and steam-pump operators, dredge engineers and cranemen, drill-boat workers, dredge firemen and laborers on dredge scows, marine pile drivers, lumber inspectors, tallymen and lumber handlers, top-deck men, cotton and tobacco screw men, general cargo deck laborers, and pool-deck hands and fishermen.

MEMBERSHIP BY DISTRICTS OF INTERNATIONAL LONGSHOREMEN'S ASSOCIATION

District	Number of Locals	Number of Members
Atlantic Coast	94	41,000
South Atlantic and Gulf	62	18,600
Great Lakes	166	14,000
Pacific Coast	54	22,000
Porto Rico	1	*
Total	377	95,600

* Not given.

The foregoing table shows an association membership of 95,600, distributed among 377 local unions.

The association includes Canada, as well as the United States, and is affiliated with the American Federation of Labor. As indicated above, it includes among its affiliated locals various unions of dock and even marine employees, which because of their large number are not listed in this report. The president is T. V. O'Connor, of Buffalo. The secretary is John J. Joyce, also of Buffalo.

Wages.—During the period of weakness of the union the attempts that were made to increase wages were unsuccessful. The hourly base rate for general cargo work on foreign vessels at New York dropped from 40 cents in 1865 to 30 cents in 1875 and to 25 cents in 1890. From that point there were two increases to 33 cents in 1915, and within the last few years there have been several large increases to 80 cents. This wage enables unskilled, as well as skilled laborers, to earn $8 a day and, since employment is more regular than formerly, the longshoreman need not be greatly concerned over the high cost of living.

All disputes over wages and other matters have, since 1917, been settled under the auspices of the National Adjustment Commission, which was formed in that year by representatives of the United States Shipping Board, the Secretary of War, the Secretary of Labor, the American Federation of Labor, the International Longshoremen's Association, and the principal shipping operators on the Atlantic and Gulf coasts. The operators on the Pacific Coast and the Great Lakes later adopted the agreement with some modifications. This commission not only made local awards but successfully sought to establish wage uniformity between the different sections. Tables that follow show the present wage rate for deep-sea and coastwise workers in the different sections. For the North Atlantic ports this rate is paid pier men and, in most instances, hold men; but at Norfolk and the South Atlantic ports the rate applies only to hold men and the rate for pier men is lower. The Pacific Coast rates have been regulated very largely by independent action of the shipping operators and the longshore union, and are undergoing change at the present time.

At all ports there are differentials for overtime; for work on

[8] "Marine and Dock Labor," 85, 86. The membership figures shown should be accepted with caution.

WAGES OF DEEP-WATER LONGSHOREMEN

Rates in Cents per Hour for General Cargo Work, July, 1914, and in Subsequent Years; Also Percentage Increase in Wages Over July, 1914

Districts	July, 1914		July, 1916		July, 1917		July, 1918		Dec., 1918		Dec., 1919	
	Wage rate	Base	Wage rate	Per Cent. increase	Wage rate	Per Cent. increase	Wage rate	Per Cent. increase	Wage rate	Per Cent. increase	Wage rate	Per Cent. increase
Boston	33	0	40	21.2	40	21.2	50	51.5	65	97.0	80	142.2
New York	33	0	40	21.2	40	21.2	50	51.5	65	97.0	80	142.2
Philadelphia	30	0	40	33.3	40	33.3	50	66.7	65	116.7	80	166.7
Baltimore	25	0	27.5	10.0	35	40.0	50	100.0	65	160.0	80	220.0
Norfolk	25	0	30	20.0	35	40.0	55	120.0	65	160.0	80	220.0
North Atlantic average	29.2	0	35.5	21.6	38	30.1	51	74.7	65	122.6	80	174.0
Charleston	20	0	20	0	25	25.0	35	75.0	50	150.0	50	150.0
Savannah	25	0	25	0	25	0	30	20.0	50	100.0	50	100.0
South Atlantic average	22.5	0	22.5	0	25	11.1	32.5	44.4	50	122.2	50	122.2
Mobile	30	0	30	0	35	16.7	50	66.7	65	116.7	80	166.7
New Orleans	40	0	40	0	40	0	50	25.0	65	62.5	80	100.0
Galveston	40	0	40	0	40	0	50	25.0	65	62.5	80	100.0
Gulf Coast average	36.7	0	36.7	0	38.3	4.4	50	36.2	65	77.1	80	118.0
San Diego	50	0	50	0	70	40.0	80	60.0	80	60.0	..	.....
San Francisco	55	0	55	0	70	27.3	80	45.5	80	45.5	..	.....
Portland	55	0	55	0	60	9.1	80	45.5	80	45.5	..	.....
Seattle	45	0	50	11.1	65	44.4	80	77.8	80	77.8	..	.....
Pacific Coast average	51.3	0	52.5	2.3	66.3	29.2	80	55.9	80	55.9	..	.....

WAGES OF COASTWISE LONGSHOREMEN

Rates in Cents per Hour for General Cargo Work, July, 1914, and in Subsequent Years; Also Percentage Increase in Wages Over July, 1914

Districts	July, 1914		July, 1916		July, 1917		July, 1918		Dec., 1918		Dec., 1919	
	Wage rate	Base	Wage rate	Per Cent. increase	Wage rate	Per Cent. increase	Wage rate	Per Cent increase	Wage rate	Per Cent increase	Wage rate	Per Cent. increase
Boston	30	0	35	16.7	35	16.7	48	60.0	65	116.7	65	116.7
New York	30	0	35	16.7	35	16.7	48	60.0	65	116.7	65	116.7
Philadelphia	22.5	0	25	11.1	30	33.3	40	77.8	65	188.9	65	188.9
Baltimore	20	0	22	10.0	25	25.0	35	75.0	65	225.0	65	225.0
Norfolk	22	0	22	0	25	13.6	40	81.8	65	195.5	50	127.3
North Atlantic average	24.9	0	27.8	11.6	30	20.5	42.2	69.5	65	161.0	62	149.0
Charleston	25	0	25	0	30	20.0	40	60.0	40	60.0	40	60.0
Savannah	22	0	22	0	27	22.7	35	59.1	40	81.8	40	81.8
Jacksonville	20	0	20	0	25	25.0	35	75.0	40	100.0	40	100.0
South Atlantic average	22.3	0	22.3	0	27.3	22.4	36.7	64.6	40	79.4	40	79.4
Mobile	30	0	30	0	35	16.7	45	50.0	45	50.0	60	100.0
New Orleans	30	0	30	0	35	16.7	45	50.0	48	60.0	60	100.0
Galveston	30	0	30	0	35	16.7	40	33.3	45	50.0	60	100.0
Gulf Coast average	30	0	30	0	35	16.7	43.3	44.3	46	53.3	60	100.0
San Diego	47.5	0	47.5	0	65	36.8	80	68.4	80	68.4	..	.....
San Francisco	50	0	50	0	65	30.0	80	60.0	80	60.0	..	.....
Portland	50	0	50	0	60	20.0	80	60.0	80	60.0	..	.....
Seattle	45	0	50	11.1	60	33.3	70	55.6	70	55.6	..	.....
Pacific Coast average	48.1	0	49.4	2.7	62.5	29.9	74.5	61.1	77.5	61.1	.....	.....

NOTE.—In April, 1921, wages for handling cargo had not materially changed. The rates for deep-water longshoremen at the five North Atlantic and the three Gulf ports remained at 80 cents per hour. At Charleston unskilled labor was paid 30 cents, winchmen 35 cents, hatch tenders 35 cents, loading cotton headers 55 cents, gangmen 40 cents. At Savannah the longshore rate for cotton was 55 cents per bale and for general cargo 40 to 45 cents per ton, common labor being paid 35 cents per hour. At Pacific Coast ports the rate was, with a few exceptions, 90 cents per hour.

holidays, during meal hours, and at night; and for handling certain commodities. These differentials are indicated in the stevedore rates shown on page 20.

Working Conditions and Their Betterment.—Now that wages have been advanced to such a point that the longshoreman can live comfortably or more than comfortably, it is noted that the members of the union are making more determined efforts to improve their working conditions. This is but natural and proper, considering the conditions under which they have worked in the past. Unquestionably the life of the average longshoreman is hard. He is never sure of work for more than a few days in advance. He must lift and carry weights of from 100 to 300 pounds. He is exposed to the cold winter storms, the burning summer sun, and the suffocating heat of the holds. He is more subject than workmen in most industries to such diseases as pneumonia, tuberculosis, bronchitis, and rheumatism, and is frequently laid up by sickness. His is a particularly hazardous trade as shown by the insurance rates charged in this and other countries. Accidents are common because of defective gear, lack of adequate safeguards, lack of supervision over the methods of work, and the necessity for handling dangerous articles. He may have to work continuously for long periods, or he may have to stand in rain or snow near the pier entrance waiting for work. Rest rooms, lunch rooms, and sanitary lavatories are almost unknown.

It will be difficult to correct all these conditions; but there should be no delay in making a start. The most necessary reform is that of regularizing the work. The creation of a central employment and paying bureau, modeled somewhat after the systems used at Liverpool, London, and elsewhere, is not impossible, though it is not feasible at present, owing to general opposition to the plan. Such a bureau would be of benefit to shipping operators and longshoremen alike because the methods of hiring, paying off, and collection of insurance would be greatly simplified. Beneficial results would also follow from the wider adoption of the weekly wage system, although it must be recognized that most stevedores must continue to pay their men on the hourly basis. The longshoremen are taking the matter of overwork into their own hands and are refusing to carry heavy weights or to work continuously for long stretches. Moreover, there is a greater installation of machinery to

assist in the movement and transfer of freight. Protection against exposure to the elements and against accidents should be afforded in every possible way. The pier superintendent and stevedore must recognize that a system of work which permits the breakdown in youth of strong men and the crippling of others by accident and disease is wasteful, as well as criminal. It is as much to the advantage of the stevedore as to the factory owner to install safety appliances and to provide decent working conditions. The cost of sun shades and wind breaks for deck men, strong ropes for the falls, lighting of the hold, brakes on the winches, and similar protective measures are small in comparison with the value of the hundreds of lives annually sacrificed because of that conservatism in the shipping work which does not permit the adoption of modern methods.

National Adjustment Commission Award.—In conclusion of this chapter the National Adjustment Commission's award of October 3, 1918, is here added as an example of the nature of agreements between longshoremen and steamship companies. It is understood, of course, that this agreement has since been modified, particularly as to rates of pay and some details. The object in introducing it here is to show the general terms of this and similar agreements with the admonition to look up the last agreement for any working information.

NATIONAL ADJUSTMENT COMMISSION

New York, N. Y., October 3, 1918.

PETITIONING PARTIES:	The International Longshoremen's Association and Affiliated Locals at ports of New York; Boston; Baltimore; Norfolk and Newport News.
OTHER PARTIES INTERESTED:	Deep-water Steamship Companies and Stevedores representing the above ports.
SUBJECT:	Readjustment of wages and working conditions of longshore labor at the above mentioned ports, submitted under the National Adjustment Commission agreement.

AWARD

The question of readjustment of wages and working conditions of longshore labor in connection with deep-water vessels at the ports of New York, Boston, Baltimore, Norfolk, and Newport News was considered by the National Adjustment Commission at meetings convening at New York City, September 30, 1918, and reconvening Tuesday, October 1, 1918, and October 2, 1918, and after hearing the parties and their testimony the Commission awards, as follows:

First.—The basic working day of eight (8) hours with Saturday half holiday, is hereby established.

Second.—On general cargo from 8 A. M. to 12 o'clock noon, of all week days, and from 1 to 5 P. M. on all week days, exclusive of Saturday, men shall receive sixty-five cents (65c) an hour.

Third.—All other time shall be counted and paid for at the rate of one dollar ($1) per hour.

Fourth.—When men are ordered out for work beginning Sunday morning, they shall be hired in regular gangs before 5 P. M. on the Saturday preceding.

Fifth.—When men are ordered out to work and do not start, EXCEPT when the men refuse to start owing to weather conditions, the men shall be paid for two (2) hours at the prevailing rate.

Sixth.—All differentials in rates of pay shall be maintained according to the agreements now in force or expiring in the various ports.

Seventh.—Except as herein otherwise provided, all other terms and conditions at the several ports mentioned shall remain as provided by the several agreements now in force or expiring at each port.

Eighth.—This award shall become effective for the ports of New York, Boston, Baltimore, Norfolk, and Newport News, as of October 1, 1918, and shall remain in effect until and including September 30, 1919, unless the National Adjustment Commission of its own motion, upon grounds of National policy, shall sooner reopen and modify the terms thereof.

(Signed) JOHN G. PALFREY, representing Shipping Board,
Acting Chairman.

EDWARD J. BARBER, representing Deepwater S. S. Employers,

T. V. O'CONNOR, representing I. L. A.

JOHN R. MCLANE, representing War Department.

Memorandum of Agreement

This agreement, made and entered into by and between the undersigned deep-water steamship lines and contracting stevedores of the Port of Greater New York and vicinity, as party of the first part, and The International Longshoremen's Association and its affiliated locals, as party of the second part—is meant to cover the loading and unloading of ships and the bunkering of same in the Port of Greater New York and vicinity, in accordance with the award of the National Adjustment Commission, dated New York, October 3, 1918, copy of which is attached hereto.

1. Members of the party of the second part to have the preference of all work pertaining to the rigging up of the ships and coaling of same as is done at the present time, and the discharging and loading of all cargoes under the following terms and conditions:

Wage Scale

2. *(a)* The basic working day of eight (8) hours with Saturday half holiday, is hereby established.

(b) On general cargo from 8 A. M. to 12 o'clock noon, of all week days, and from 1 to 5 P. M. on all week days, exclusive of Saturday, men shall receive sixty-five cents (65c) an hour.

(c) All other time shall be counted and paid for at the rate of one dollar ($1) per hour.

(d) Legal Holidays are: New Year's Day, Lincoln's Birthday, Washington's Birthday, Good Friday on the Jersey Shore, Decoration Day, Fourth of July, Labor Day, Columbus Day, Election Day, Thanksgiving, Christmas, and such other National or State holidays as may be appointed by Executive Authority.

(e) Men employed on bulk cargo, ballast, and all coal cargoes, including loading and trimming coal for a steamer's own bunker purposes, to receive seventy cents (70c) per hour between the hours of 8 A. M. and 12 o'clock noon, and from 1 to 5 P. M., except Saturday, when the workday shall be from 8 A. M. to 12 o'clock noon. All other time to be considered as overtime and paid for at one dollar and five cents ($1.05) per hour.

(f) Men are to work any night of the week or Sunday when required. Work performed on Saturday night only to finish ship for sailing Sunday, or to handle mail or baggage.

(g) Only baggage and mail to be handled on Labor Day, at one dollar ($1) per hour.

3. *(a)* When men are handling explosives down the Bay the following scale to apply:

	Day Work *per hour*	Holidays, Sunday and Afternoon Saturday *per hour*
8 A. M. to 12 noon 1 P. M. to 5 P. M.	.....$1.30.....	..... $2.00
1 A. M. to 6 A. M. 7 A. M. to 8 A. M. 5 P. M. to 6 P. M. 7 P. M. to 12 midn't	.....$2.00.....	..... $2.00
6 A. M. to 7 A. M. Noon to 1 P. M. 6 P. M. to 7 P. M. 12 midn't to 1 A. M.	.....$2.60.....	..... $2.60

Time to start from the time of leaving pier until the time of return to pier. Men to supply their own meals, but fifty cents (50c) per meal to be allowed by the employers.

(b) Explosives such as are customarily handled down the Bay when handled at any pier, shall be paid for double time. If dispute arises as to what explosives are, it shall be settled by the Bureau of Explosives, whose decision shall be final and accepted by both sides.

(c) That the rates in Class 2 are to apply on general cargo of every description, including barrel oil when part of general cargo.

Kerosene, gasoline and naphtha in cases, when loaded by case oil gangs, or with a fly, to pay eighty-five cents (85c) per hour. All other time to be one dollar and twenty-five cents ($1.25) per hour.

4. Every effort will be made to arrange for the men to receive their wages at a locality as convenient as possible to the place at which they have performed the work.

5. *(a)* When men are ordered out for work beginning Sunday morning, they shall be hired in regular gangs before 5 P. M. on the Saturday preceding.

(b) When men are ordered out to work and do not start, EXCEPT when the men refuse to start owing to weather conditions, the men shall be paid for two (2) hours at the prevailing rate.

6. The stevedore is to hire the men. No hiring to be done by hatch bosses, but the stevedore may authorize the under foreman to do so.

7. When men are knocked off work fifteen minutes after the hour or later they are to be paid for one-half hour. If they knock off forty-five minutes after the hour they are to be paid for one hour.

8. When it would take more than ten minutes to replace the hatch covers the gangs are to be knocked off ten minutes before quitting time.

9. No chemicals improperly packed or in any but first-class shipping condition are to be accepted or loaded on board ship. If any question arises regarding the condition of this class of cargo, the matter to be left to the proper authority, whose decision will be final.

10. If a ship has been on fire or ashore, all cargo damaged by either fire or water is to be handled at the rates under clause 3, but sound cargo in a separate compartment is to be handled at the rates under clause 2. When rubbers are required for handling wet cargo or explosives, or leather hand pads or gloves for barb wire, they shall be provided by the stevedore or company.

11. The steamer is to supply suitable protection for men working on deck in bad weather.

12. It is expressly understood and agreed that in case of dispute, no stoppage of work shall occur under any circumstances, and that any dispute arising under this agreement which cannot be immediately settled by arbitration shall be referred to the Local Adjustment Commission, appointed by the authorities in Washington, and if the matter cannot be adjusted by said Commission, it shall be referred to the National Adjustment Commission in Washington, whose decision shall be final.

13. There shall be no beer or other intoxicating liquor brought upon the property of the party of the first part. For a violation of this clause the guilty party may be discharged and given no further employment by the party of the first part. It is clearly agreed that no men are to be allowed to leave the pier during working hours for the purpose of obtaining drink, or for any purpose whatever except with the express permission of the foreman stevedore in charge. The steamship companies agree to supply proper drinking water on pier, also adequate and cleanly toilet facilities.

14. The party of the second part will not try to uphold incompetency, shirking of work, pilfering or poaching of cargo; any man guilty of the above offenses shall be dealt with as the party of the first part sees fit, or as the circumstances may require. If any man is convicted of theft, he shall be expelled from the union.

15. There shall be no discrimination by the party of the first part against any member of the party of the second part, nor shall the party of the second part discriminate against the party of the first part.

16. All conditions of labor, including the number of men in holds for loading and discharging, not herein mentioned, to remain as at present.

17. When the party of the second part cannot furnish a sufficient number of men to perform the work in a satisfactory manner, then the party of the first part may employ such other men as are available.

18. Men working on piers on the North and East Rivers above Seventy-fifth Street, or on piers at Weehawken, West New York, Yonkers, Long Island City, Staten Island, and Bayonne to receive not more than sixty-five cents (65c) per day to cover time and expenses going to and from place of employment, it being understood that the discretion as to the actual traveling time required by the man in each instance shall be left in the hands of the employer.

19. A copy of this agreement to be filed with the War Department, United States Shipping Board, and National Adjustment Commission, at Washington, D. C.

20. THIS AGREEMENT will go into effect October 1, 1918, and will remain in full force and effect until September 30, 1919, unless the National Adjustment Commission of its own motion, upon grounds of National policy, shall sooner reopen and modify the terms thereon.

Signed for Employers.

Signed for International Longshoremen's Association.

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CHAPTER V

ACCOUNTING AND PAPER WORK[1]

Nearly every one of our four million officers and men in the World War learned what the army term "paper work" (P.W.) means. It is a terse expression in any organization for all the slips, reports, forms, receipts, and other papers that are necessary to keep an orderly record and account of the business. The paper work on a wharf handling millions of dollars of merchandise is very important. To do it justice would require at least a volume of the size of this one. Such a work has yet to be written. This chapter will endeavor to show the chief forms and the reasons for them.

Steamship Accounting

The wharf paper work must be in harmony with the accounting system of the line and, therefore, a knowledge of the outstanding features of that system is necessary on the wharf.

Steamship accounting is based upon "the voyage account" and the "general expense account." The former is similar to the contract or job account in constructing companies such as elevator builders, engineering contractors, etc. The general expense account contains those items that cannot be assigned as part of the expense of carrying out a particular contract. Figures 3 and 4 illustrate the divisions without very much explanation.

The Voyage Account.—The accounting begins with the voyage, as this adventure, with others, is the reason for being in business. The receipts from each voyage, less the expenses for that voyage, determine if the voyage was a profitable venture. Every item of receipt or expense that can be logically assigned to a particular voyage is put into the voyage account. There are many expenses, however, that go on just the same regardless of whether this par-

[1] By R. S. MacElwee.

Pw. 1.

DUN

VOYAGE ACCOUNT

From _____ 191__
Arrived _____ 191__
From _____ 191__
Arrived _____ 191__

S. S. _____ Voy. _____

Receipts	WEST	EAST	TOTAL
PASSENGER	$	$	$
FREIGHT			
MAIL			
WINE, ETC.			
SUNDRIES			
	GROSS VOYAGE EARNINGS		

Disbursements	WEST BOUND Europe	WEST BOUND America	EAST BOUND America	EAST BOUND Europe	TOTAL	
PASSENGER		$	$		$	
1. PROVISIONS						1
2. WAGES						2
3. AGENT'S COMMISSIONS						3
4. HEAD TAX						4
5. BAGGAGE CLAIMS AND EXPENSES						5
6. BOARD AND DETENTION "						6
7. CUSTOM HOUSE EXPENSES						7
8. TRANSFER CHARGES						8
9. EXPENSES AT PORT OF CALL						9
10. SUPPLIES						10
11. REPAIRS						11
12. INSURANCE ON PASSAGE MONEY						12
13. INCIDENTALS						13
14.						14
Total						
19. SUB-AGENT'S COMM'S (To be deducted from gross earnings)						19
20. INLAND TRANS. " " "						20
FREIGHT						
LOADING AND DISCHARGING CARGO						
31. Grain — Overtime Included						31
32. Cattle — West. East.						32
33. Fresh Meat — Bur.						33
34. Labor — Am.						34
35. Moving Cargo on Pier						35
36. Coaperage						36
37. Customs and Harbor Dues						37
38. Alterations and Repairs						38
39. Towage and Lighterage						39
40. Wharf Employees						40
41. Incidentals						41
42.						42
43. COMMISSIONS						43
44. INSURANCE ON FREIGHT MONEY						44
45. LOSS AND DAMAGE CLAIMS						45
46. BALLAST EXPENSES						46
47.						47
Total Freight Expenses						
49. INLAND FREIGHT (To be deducted from gross earnings)						49
50. SUB-AGENT'S COMMISSIONS " " "						50
STEAMSHIP						
61. PORT CHARGES: Pilotage and Towage						61
62. Wharfage and Dock Dues						62
63. Customs and Harbor Dues						63
64. Incidentals						64
65. DECK DEPT. Wages						65
66. Provisions						66
67. Supplies						67
68. Repairs						68
69. Incidentals						69
Total Deck Dept.						
70. ENGINE DEPT.: Wages						70
71. Provisions						71
72. Coal						72
73. Supplies						73
74. Repairs						74
75. Incidentals						75
Total Engine Dept.						
76. PROTECTION AND MARINE INSURANCE						76
77. EXPENSES AT PORT OF CALL						77
Total Steamship Expenses						
79. MAIL EXPENSES						79
80. WINE, TOBACCO, ETC.						80
GRAND TOTAL						
					VOYAGE RESULT $	
					ESTABLISHMENT CHARGES $	
Number of days on round voyage						

FIG. 3.—VOYAGE ACCOUNT.

ticular voyage took place or not. At the end of the year the other-than-voyage expense must be deducted from total voyage profits to show the net earnings of the steamship enterprise.

It will be noted:

1. A "voyage" is out and back, a "round voyage."

2. Receipts are fairly simple: passenger, freight, mail, wine (smoking room, etc.), sundries.

3. Disbursements are subdivided into many items, and each item is given a number that is shown in both margins. The main headings for expenses are Passenger, Freight, and Steamship.

4. Under "Freight" are several important accounts that come under the wharf superintendent, while the steamship charges are under the marine superintendent. Items 31 to 36 are in connection with "Loading and discharging cargo"; also Nos. 37, 38, 39, 40, 45 and 46. These items are all quite obvious, yet it is sometimes difficult to debit the correct account with some unusual item of expense.

Under "Expenses not apportioned to voyage accounts" (Fig. 4), the items are assigned numbers above 100. The groups are: Salaries of officers and clerks, Office expenses, Advertising, Wharf expenses, and Lay-up expenses.

Common office expenses are prorated among the various branch offices according to an agreed schedule; that is, in proportion to the amount of business done by each office.

Papers for Inbound Freight.—As the ship must first discharge its freight before loading, it is logical to begin with inbound (at Atlantic ports of the United States, westbound) freight.

Forms of the International Mercantile Marine Company from both the Philadelphia and New York offices are used as fairly representative examples.

Tally Slip.—Goods landed from the ship for eventual delivery to consignees or received at the wharf must be measured and counted. There are two tally slips for this purpose: one for the delivery clerk's office (Fig. 5), and one for the receiving clerk's office (Fig. 6). The checkers or tally clerks measure the packages, enter marks, and tally the packages of shipments. In the case of large shipments in bags, barrels, etc., there may be several hundred pieces in one shipment. The tally clerk marks up the score by making four vertical strokes and one across, forming groups of five.

P.W.2.

Expenses Not Apportioned to Voyage Accounts

DURING MONTH OF 191

							Total	
101	Salaries of Officers and Clerks	$	$	$	$	$	$	101
	OFFICE EXPENSES							
104	Rent and Taxes							104
105	Office Supplies							105
106	Postage							106
107	Telegrams, Cables & Phones							107
108	Insurance							108
109	Light and Fuel							109
110	Repairs to Offices & Furniture							110
111	Legal Expenses							111
112	Travelling Expenses							112
113	Contributions							113
114	Dues to Associations							114
115	Entertaining Expenses							115
116	Incidentals							116
118	Directors' Fees							118
	Total Office Expenses							
	ADVERTISING							
120	Pictures and Frames							120
121	Fancy Ads., Posters, etc.							121
122	Regular Newspapers							122
123	Special Newspapers							123
124	Special Announcements							124
125	Postage and Reprenage							125
126	Sundry							126
	Total Advertising Expenses							
	WHARF EXPENSES							
151	Salaries and Wages							151
152	Rents and Taxes							152
153	General Repairs							153
154	Telegrams, Cables & Phones							154
155	Insurance							155
156	Water and Supplies							156
157	Incidentals							157
158	Power & Wharf Machinery Wages							158
159	Floating Hoisters							159
160	Supplies							160
161	Repairs							161
162	Stevedore Gear: Supplies							162
163	Repairs							163
	Total Wharf Expenses							
170	Lay-up Expenses							170
	Proportion from other lines							
	Total							

COMMON OFFICE EXPENSES (Proportion)	Steamship	Passenger	Freight		
Boston	$	$	$		
Chelsea Piers, Officers Club and Passenger Office					
Chicago					
Minneapolis					
Montreal					
New Orleans					
New York					
New York Operating Department					
Philadelphia					
Pittsburgh					
San Francisco					
Seattle					
St. Louis					
Toronto					
Washington					
Winnipeg					
London, Cockspur Street					
" Leadenhall Street					
Queenstown					
Southampton					
Comptroller's Department					
			Grand Total		

FIG. 4.—GENERAL EXPENSE, OTHER THAN VOYAGE.

In the case of mixed shipments, or when two or three packages are landed together, figures are entered on the slip. The general arrangement of this important piece of paper is seen from the illustrations.

D7468 **I. M. M. CO. WHARF**

New York, _____ 19

To DELIVERY CLERK:

Steamer _____ Com'nced _____

Lighter _____ Finished

MARKS	PACKAGES

FIG. 5.

D7468 **I. M. M. CO. WHARF**

New York, _____ 19

To RECEIVING CLERK:

Steamer _____ Com'nced _____

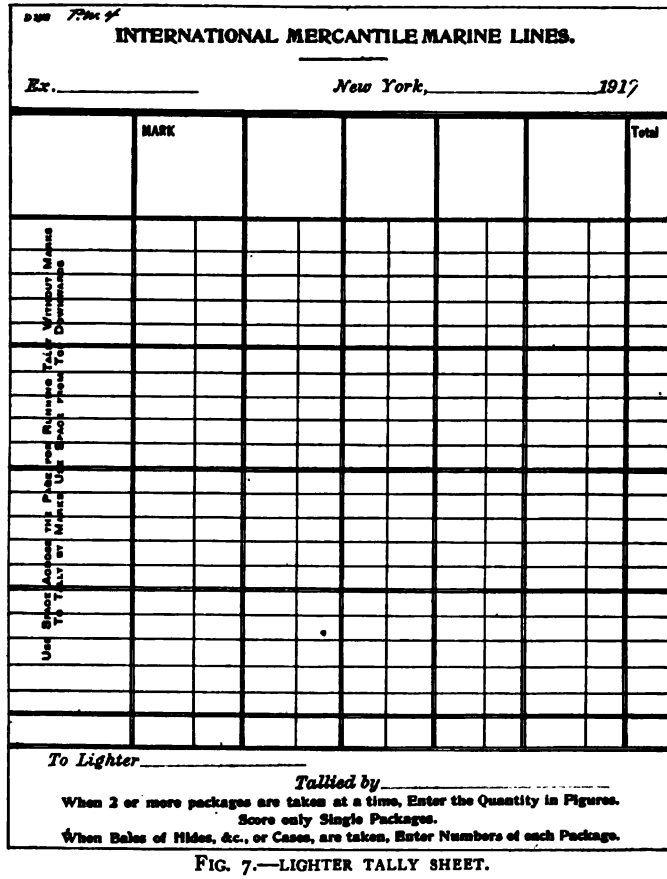
Lighter _____ Finished _____

MARKS	PACKAGES

FIG. 6.—TALLY SLIPS.

Lighter Tally Sheet.—Goods discharged from ship to lighter are tallied on a more elaborate sheet (Fig. 7). This sheet shows from what steamer discharged, the date, the marks, tallies and totals, to what lighter delivered, and by whom tallied.

The Discharging Receipt Book.—While at sea the pursers make up the discharging receipt book from the manifest and bills of lading. This is a book of two hundred numbered pages of legal cap size. One book is necessary for each port at which cargo is dis-



INTERNATIONAL MERCANTILE MARINE LINES.

*Ex.*_____ *New York,*_____ *1917*

	MARK										Total
Use Space Across the Page for Running Tally Without Marks To Tally by Marks Use Space from Top Downwards											

*To Lighter*_____

*Tallied by*_____

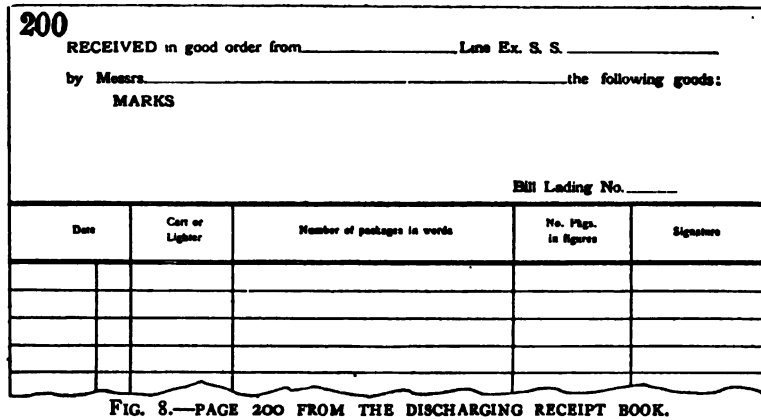
When 2 or more packages are taken at a time, Enter the Quantity in Figures.
Score only Single Packages.
When Bales of Hides, &c., or Cases, are taken, Enter Numbers of each Package.

FIG. 7.—LIGHTER TALLY SHEET.

charged, for the guidance of the delivery clerk. The cover bears the serial number of the book, the name of the steamship, the port of loading, and the date of arrival.

Each sheet (Fig. 8) should carry one entry only. Small consignments are entered two and sometimes three to the page. The page shows the line, the steamer, the consignee, the marks, and the bill-of-lading number. The body of the sheet has the number of

packages in words and in figures filled in when it reaches the delivery clerk. When delivery is accomplished, the date and the cart or lighter to which delivery is made are entered, and the truckman or other authorized person taking delivery signs for the goods in the last column. All additional remarks, such as short shipment, damages, goods sent to appraiser's stores, consignment sent to general order stores, etc., are noted on the page under the entry as they



200

RECEIVED in good order from _____ Lane Ex. S. S. _____

by Messrs. _____ the following goods:

MARKS

Bill Lading No. _____

Date		Cart or Lighter	Number of packages in words	No. Pkgs. in figures	Signature

FIG. 8.—PAGE 200 FROM THE DISCHARGING RECEIPT BOOK.

occur. It should be possible to look at the discharging receipt book at any time and know the status of every consignment from a given steamer.

The discharging receipt book record, however, is not sufficient. There are many forms in connection with it that cover many things that may occur in connection with a shipment.

Records of Damaged Cargo.—One of the first irregularities to be noted are damages to cargo. Careful record of this is important because of claims. Damages are usually detected upon landing by the tallyman, whereupon a certificate of goods landed in damaged or "ullaged" condition is made out and signed by the master or chief mate. Figure 9 is a sample from the *Saluda*, properly filled out. This form gives the port, date, and the statement: "This is to certify that the following packages were landed from on board the *Saluda* in ullaged condition." Then follows the statement noting B/L number, marks, and a statement of the nature of the damage. This form is executed in triplicate, of which two copies are retained at the office and one sent to the claims department of the head office.

Philadelphia, 8/29/19 19

This is to certify that the following packages were landed from on board s/s Salida in ullaged condition.

B/L			
1,2,11	Various	number bales wool wrappers torn-6 bales (X) landed in bulk	
3,4,19	KB	481 bags ginger, old bags, all more or less torn part out, quantity of loose root landed in bulk,	
6	HKS	1 case mustard, 6 bottles broken,	

Signed G. Kegeleers, Chief Mate.

FIG. 9.—SHIP OFFICER'S REPORT OF DAMAGED CARGO.

REPORT OF DAMAGED CARGO.

Steamship SALIDA Voy. Arrived Philadelphia 9/12/19 19

B/L Dft.	Consignee	Marks	Numbers	Packages	Kinds	Name of Damage	When Found	REMARKS
1,2,11	Various	Various		Number bales	wool	Wrappers torn	6 bales	landed in bulk (X)
3,4,19	"	KB	B/H	481 bags	ginger root	old bags all more or less torn part out quantity of loose root landed in bulk.		
6	H. Kellogg & Son	HKS		1 case	mustard	6 bottles broken		

Signed S. A. Scholl, Dock Supt.
Charles Thomas, Receiving Clerk.

FIG. 10.—DOCK SUPERINTENDENT'S OR RECEIVING CLERK'S REPORT OF DAMAGED CARGO.

Report of Damaged Cargo.—The receiving clerk's office on a special form (Fig. 10) makes out its own report of the damages to cargo; usually the entries include the same information as that given by the ship's officer. This report is signed by the receiving clerk

INTERNATIONAL MERCANTILE MARINE LINES

American Line — Red Star Line
Atlantic Transport Line — White Star Line
Panama Pacific Line

19

SPECIAL DAMAGE REPORT

Steamer ..... Voy ..... B/L ..... Arrived 191

Merchandise ..... Marks .....

Consignee .....

What was the exact Stowage? .....

Was Compartment under Lock? .....

Was Merchandise Referred to Immediately Available on Opening of Hatches? .....

What Cargo was stowed around it, and was any Cargo stowed on top of it? .....

.....

At what Time were Hatches Opened? .....

At what Time did Discharging Begin? .....

At what Time was Damage Discovered? .....

Was Hatch Left Open at any time Unprotected, If so, explain why? .....

Name of Man who Discovered Damage .....

Name of Foreman in Charge of Hatch .....

Names of Men Working in Hatch .....

.....

Name of Officer on Watch .....

Name of Official to whom Damage was Reported .....

In your opinion did Loss or Damage occur during the loading on voyage or after arrival of steamer?

.....

Remarks and Particulars of Loss or Damage? .....

.....

.....

.....

..... Chief Clerk.

No. ..... Chelsea Piers. ..... Sup't.

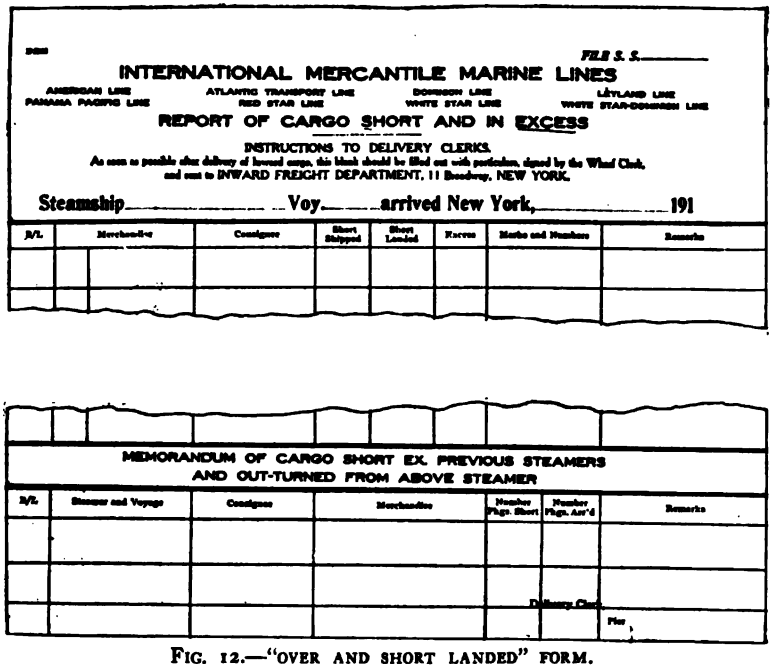
New York, ... 191 ..... Officer.

FIG. 11.—SPECIAL REPORT OF UNUSUAL OR EXTENSIVE DAMAGE OR IN CASE OF EXCESSIVE CLAIMS.

and by the wharf superintendent. It is executed in triplicate: one copy to Liverpool, or port of departure of merchandise, one to the office file, and one to the admiralty surveyor (insurance adjuster).

Special Damage Report.—In cases of unusual and extensive damage, or excessive claims, a special report (Fig. 11) is required from the ship's officers and wharf superintendent. It also is signed

by the clerk making the investigation. The question sheet covers pertinent contributory evidence. It includes the name of the ship, the voyage, the B/L number, marks, date arrived in port, the nature of the merchandise, the consignee, then the questions: What was the exact stowage? Was the compartment under lock (for pilferage)? Was merchandise referred to immediately available on opening of



FILE S. S.

INTERNATIONAL MERCANTILE MARINE LINES

AMERICAN LINE · ATLANTIC TRANSPORT LINE · DOMINION LINE · LEYLAND LINE
PANAMA PACIFIC LINE · RED STAR LINE · WHITE STAR LINE · WHITE STAR-DOMINION LINE

REPORT OF CARGO SHORT AND IN EXCESS

INSTRUCTIONS TO DELIVERY CLERKS.

As soon as possible after delivery of inward cargo, this blank should be filled out with particulars, signed by the Wharf Clerk, and sent to INWARD FREIGHT DEPARTMENT, 11 Broadway, NEW YORK.

Steamship_____ Voy._____ arrived New York,_____ 191

B/L	Merchandise	Consignee	Short Shipped	Short Landed	Marks	Marks and Numbers	Remarks

MEMORANDUM OF CARGO SHORT EX. PREVIOUS STEAMERS AND OUT-TURNED FROM ABOVE STEAMER

B/L	Steamer and Voyage	Consignee	Merchandise	Number Pkgs. Short	Number Pkgs. Am'd	Remarks

Delivery Clerk

Pier

FIG. 12.—"OVER AND SHORT LANDED" FORM.

hatches? What cargo was stowed around it, and was any cargo stowed on top of it? At what time were hatches opened? At what time did discharging begin? At what time was damage discovered? Was hatch left open at any time unprotected; if so, explain why? Name of man who discovered damage. Names of men working in hatch. Name of officer on watch. Name of official to whom damage was reported. In your opinion did loss or damage occur during the loading, on voyage, or after arrival of steamer? Remarks and particulars of loss or damage.

Over and Short Landed.—Another irregularity after damage is "short landed" or missing packages, or more packages landed than

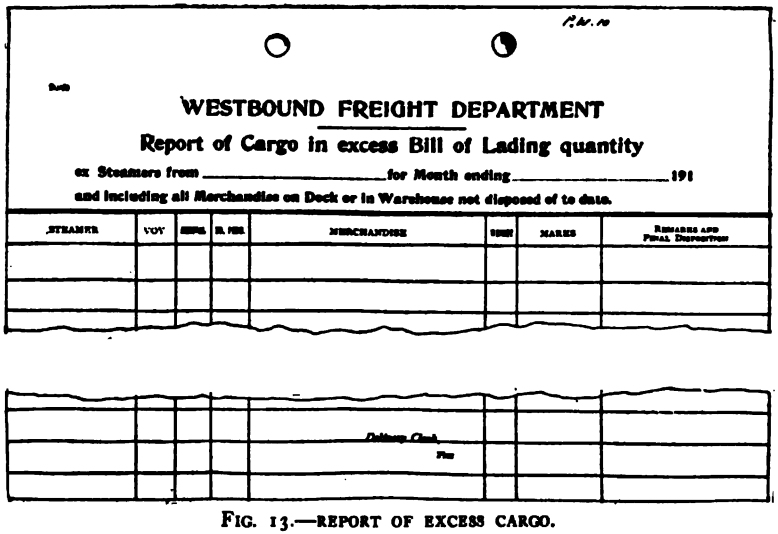
shown in the manifest or discharging receipt book. With the present congestion of wharves the world over, it is very easy for some of the packages of a shipment to be put on to the wrong steamer. Out of the 530 barrels of mackerel shipped to S. H. Levins' Sons, there was one barrel missing at Philadelphia. In Buenos Aires the delivery clerk may find that he has a barrel of mackerel, Mark B, landed from a vessel for which he has no papers and no record. The delivery clerk at Philadelphia notifies the port of loading (Liverpool) that he is "short," the delivery clerk at Buenos Aires notifies Liverpool that he has a barrel of mackerel "over." In due time he is notified to ship the barrel to Philadelphia on the next available steamer of the line or back to Liverpool for transshipment.

On some future form (Fig. 12) at the bottom of the page there will be noted that one barrel of mackerel "short" on the steamer *Saluda*, voyage No. ——, has arrived. Needless to say, the mackerel will not have become any better in the meantime and Messrs. S. H. Levins' Sons will have long since entered a damage claim for the merchandise. The "over and short landed" form is made out in triplicate, one copy is retained, one sent to the claims department, head office (New York), and one to the port at which the merchandise was loaded (Liverpool). The form is signed by the delivery clerk and the wharf superintendent.

The same company in New York uses a form, "Report of Cargo Short and in Excess," which bears the printing, "Instructions to Delivery Clerks. As soon as possible after delivery of inward cargo, this blank should be filled out with particulars, signed by the wharf clerk, and sent to Inward Freight Department, 11 Broadway, New York."

Monthly Report of Cargo in Excess (over) Bill of Lading Quantity.—The report made at the time the vessel is discharged is not sufficient for all purposes. Over or in-excess cargo accumulates and must be disposed of in order to make room on the wharves and in warehouses. An excellent example of what may happen when no final disposition of such merchandise can be made is given by the Port of Havana Docks Company, at Havana, Cuba. In this case all goods not claimed and delivered were sent to storage in the bulkhead warehouses. The customs regulations require that the goods be held six months and, if not claimed, sold at auction to cover customs and storage charges. The customs auctioneer had followed the

practice of refusing sale if the bids did not cover these charges. All merchandise is more or less perishable and it is conceivable that our barrel of mackerel cited above would not be worth the duty and six months' storage, and would not be sold. Thus had accumulated at Havana such odds and ends until one-seventh of the total valuable floor space of the terminal was taken up by them and withheld from active use. The manager had a monthly report of seventy-one such sheets as Figure 13.



WESTBOUND FREIGHT DEPARTMENT

Report of Cargo in excess Bill of Lading quantity

ex Steamers from _____ for Month ending _____ 191

and including all Merchandise on Dock or in Warehouse not disposed of to date.

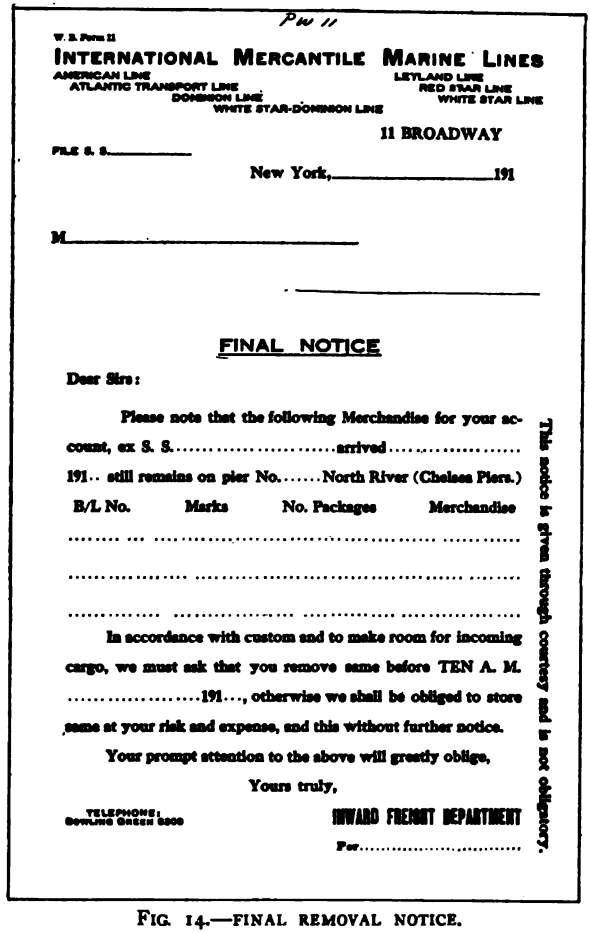
STEAMER	VOY	[illegible]	[illegible]	MERCHANDISE	[illegible]	MARKS	REMARKS AND FINAL DISPOSITION

FIG. 13.—REPORT OF EXCESS CARGO.

It will be noted that the monthly report will require a separate sheet for each foreign port. The original goes to the westbound freight department, one copy to foreign port, and one is retained. This report serves two purposes: it indicates at a glance the amount of the accumulation of merchandise and acts as a check on previous reports that may be easily scanned.

Notice to Remove Merchandise.—One of the foundation principles of any well-managed wharf is that merchandise must be kept moving and must not be permitted to remain on the wharf longer than is necessary to assemble it for customs inspection and delivery to consignee. If goods are permitted to remain on the wharf they add to the congestion and confusion that is already too costly. One of the principal causes of the complete breakdown of the

Port of Havana, Cuba, in 1920, was the fact that on all privately owned wharves the storage rates were very low and calculated monthly. It was much cheaper for a merchant to use the wharves for the storage of his merchandise than to provide his own warehouse.



Pw 11

W. S. Form 11

INTERNATIONAL MERCANTILE MARINE LINES

AMERICAN LINE
ATLANTIC TRANSPORT LINE
DOMINION LINE
WHITE STAR-DOMINION LINE
LEYLAND LINE
RED STAR LINE
WHITE STAR LINE

11 BROADWAY

FILE S. S._____

New York,_____191

M_____

FINAL NOTICE

Dear Sirs:

Please note that the following Merchandise for your account, ex S. S.....arrived.....191.. still remains on pier No.....North River (Chelsea Piers.)

B/L No.	Marks	No. Packages	Merchandise
.....	...	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....

In accordance with custom and to make room for incoming cargo, we must ask that you remove same before TEN A. M. .....191..., otherwise we shall be obliged to store same at your risk and expense, and this without further notice.

Your prompt attention to the above will greatly oblige,

Yours truly,

TELEPHONE: Bowling Green 8200

INWARD FREIGHT DEPARTMENT

Per.....

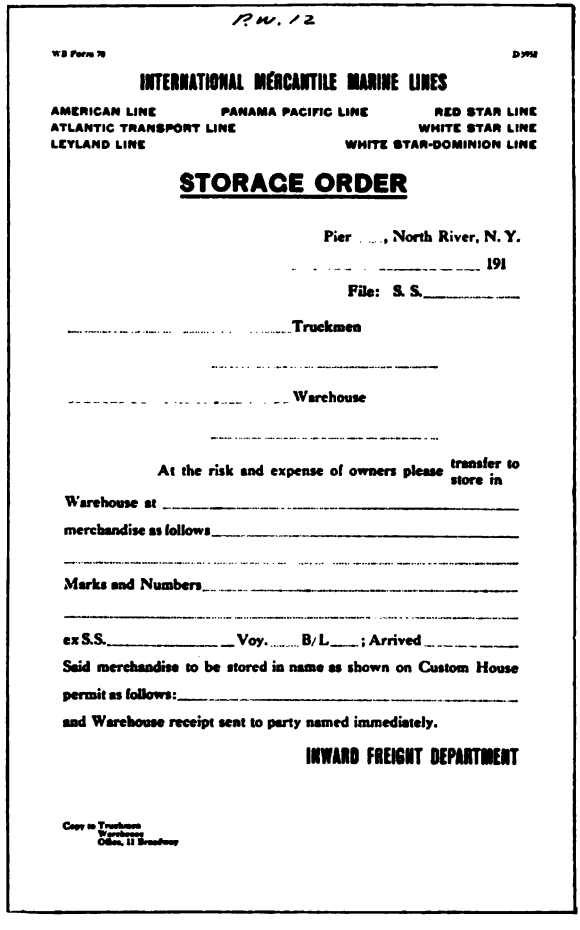
This notice is given through courtesy and is not obligatory.

FIG. 14.—FINAL REMOVAL NOTICE.

Even if a punitive wharfage rate after forty-eight hours should be assessed, in order to force the consignee to take delivery of his goods, there are always odds and ends of in-excess and unclaimed shipments that must be removed to some warehouse to clear the wharves for working the ships. Therefore it is a better policy, now fairly general, for the wharf superintendent to remove from the

wharf to warehouses all merchandise remaining after forty-eight hours. The expense of cartage, etc., is charged to the merchandise and is paid by the consignee before receiving the goods.

The delivery clerk sends to the consignee a notice as indicated by Figure 14.



P.W. 12

WB Form 70 D3952

INTERNATIONAL MERCANTILE MARINE LINES

AMERICAN LINE PANAMA PACIFIC LINE RED STAR LINE
ATLANTIC TRANSPORT LINE WHITE STAR LINE
LEYLAND LINE WHITE STAR-DOMINION LINE

STORAGE ORDER

Pier ....., North River, N. Y.

..... 191

File: S. S._____

_____Truckmen

_____

_____Warehouse

_____

At the risk and expense of owners please transfer to / store in

Warehouse at _____

merchandise as follows_____

_____

Marks and Numbers_____

_____

ex S.S._____Voy.....B/L____; Arrived_____

Said merchandise to be stored in name as shown on Custom House

permit as follows:_____

and Warehouse receipt sent to party named immediately.

INWARD FREIGHT DEPARTMENT

Copy to Truckmen
Warehouse
Office, 11 Broadway

FIG. 15.—STORAGE ORDER TO TRUCKING COMPANY TO TRANSFER MERCHANDISE FROM WHARF TO PUBLIC WAREHOUSE.

Storage Order.—At the expiration of the stated period, in fact sometimes in advance of the exact hour, to save time, a storage order (Fig. 15) is issued to a trucking company, naming the warehouse with the statement:

At the risk and expense of owners please transfer to and store in warehouse at....., merchandise as follows:.....; marks and numbers, ...; ex S. S.....; voyage .....; B. L.....; Arrived..... Said merchandise to be stored in name as shown on customhouse permit as follows:..... and warehouse receipt sent to party named immediately. INWARD FREIGHT DEPARTMENT.

Pier No. ____ N. R. New York, ____ 19__

Goods sent to General Order Store ____

S. S. ____ Voy. ____ Arrived ____ 19__

B/L	MARKS AND NUMBERS		PKGS. AND CONTENTS			REMARKS

A

FIG. 16.

CARGO SENT ON GENERAL ORDER.

9/2 19 9

Steamship Salinda Voy. Arrived Philadelphia, 8/12/19 19

No. BILL	CONSIGNEE.	MARKS.	NUMBERS.	PACKAGES.		MDSE.	WHERE STORED.	LIEN FILED.
8		(S) (F)		15	casks	palm oil	8/25/19 Atlantic Stores.	
	9							

R. A. Sobell, Dock Supt.
Charles Titton, Receiving Clerk.

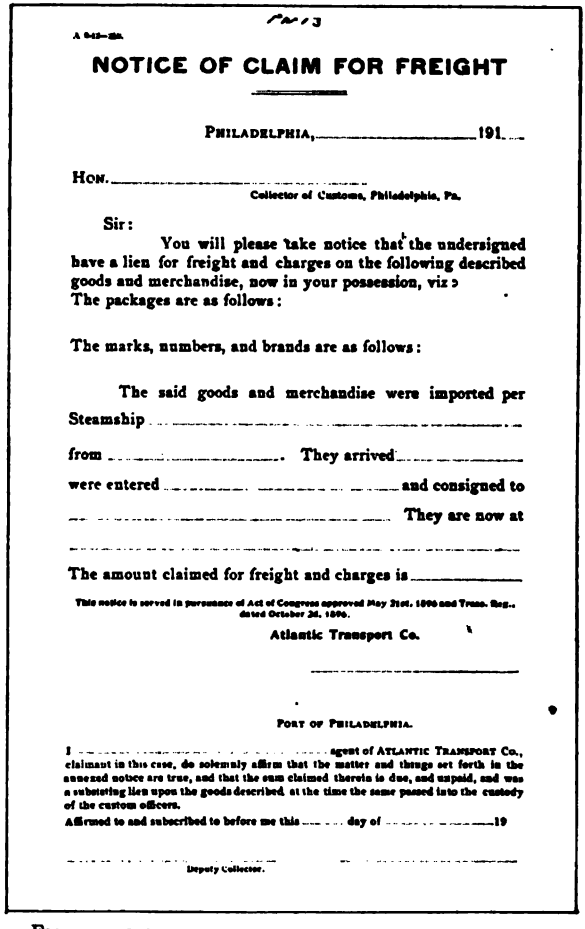
B

FIG. 16.—RECORD OF CARGO SENT TO GENERAL ORDER STORES.

Four copies are made: one to truckman, one to warehouse, one to office, one retained at pier. Entry is made in the discharging receipt book that the merchandise has been sent to general-order warehouse so and so.

List of Goods Sent to General Order Store.—In addition to the

entry in the discharging receipt book and the brief mention of the marks and numbers in the storage order, a list of the merchandise in some detail is necessary as a full record of their disposition. This list is made out in triplicate: one copy to Liverpool, one to claims department, and one to office file (Figs. 16a and 16b).



NOTICE OF CLAIM FOR FREIGHT

PHILADELPHIA, _____ 191__

HON. _____
Collector of Customs, Philadelphia, Pa.

Sir:

You will please take notice that the undersigned have a lien for freight and charges on the following described goods and merchandise, now in your possession, viz:
The packages are as follows:

The marks, numbers, and brands are as follows:

The said goods and merchandise were imported per Steamship _____

from _____. They arrived _____

were entered _____ and consigned to

_____ They are now at

_____

The amount claimed for freight and charges is _____

This notice is served in pursuance of Act of Congress approved May 31st, 1896 and Treas. Reg., dated October 3d, 1896.

Atlantic Transport Co.

_____

PORT OF PHILADELPHIA.

I _____ agent of ATLANTIC TRANSPORT CO., claimant in this case, do solemnly affirm that the matter and things set forth in the annexed notice are true, and that the sum claimed therein is due, and unpaid, and was a subsisting lien upon the goods described at the time the same passed into the custody of the custom officers.

Affirmed to and subscribed to before me this ____ day of _____ 19

_____
Deputy Collector.

FIG. 17.—LIEN NOTICE TO THE COLLECTOR OF CUSTOMS.

Customs Lien Notice.—When the line has not been paid freight or other expenses, such as cartage to general stores and warehouse charges, and the goods have not been cleared through the customs, the delivery clerk notifies the customs not to release the merchandise to the consignee until such charges have been paid. Under the bill-

of-lading contract the steamship company reserves the right of holding the merchandise until its claims have been paid. The lien notice (Fig. 17) reads as follows:

SIR: You will please take notice that the undersigned have a lien for freight and charges on the following described goods and merchandise, now in your possession, viz.: The packages are as follows:

The marks, numbers, and brands are as follows:..... The said goods and merchandise were imported per Steamship ..... from..... They arrived..... ....., were entered....., and consigned to ..... They are now at..... The amount claimed for freight and charges is..... This notice is served in pursuance of Act of Congress approved May 21, 1896, and Treas. Reg., dated October 2, 1896. Signed, ATLANTIC TRANSPORT COMPANY.

I, ..., agent of ATLANTIC TRANSPORT COMPANY, claimant in this case, do solemnly affirm that the matter and things set forth in the annexed notice are true, and that the sum claimed therein is due and unpaid, and was a subsisting lien upon the goods described, at the time the same passed into the custody of the custom officers. Affirmed to and subscribed to before me this ..... day of .....192..... Signed, Deputy Collector.....

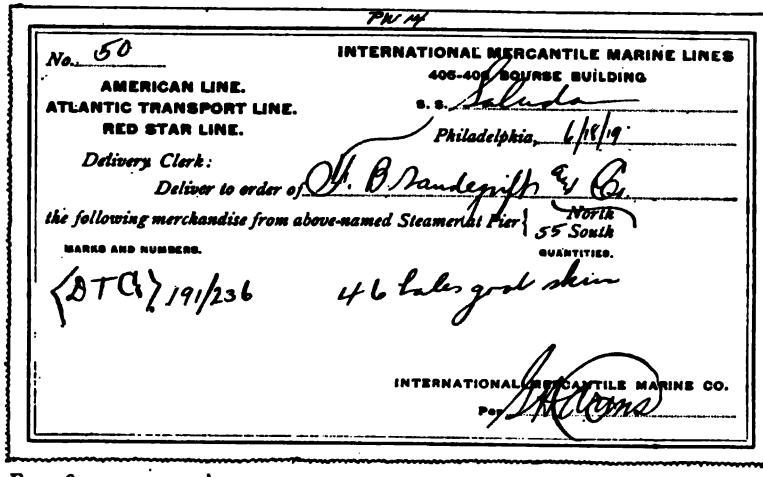
Note that this document must be sworn to before a deputy collector. The form is executed in duplicate: one copy to the custom-house and one retained.

These, then, are the most important papers connected with inbound freight and handled by the delivery clerk's office.

Delivery Order.—When all freight charges and formalities have been taken care of the truckman is given a delivery order addressed to the delivery clerk saying: "Deliver to order of.....the following merchandise from above-named steamer at Pier No..... (marks and numbers)....." This form (Fig. 18) is a pass for the truckman with the merchandise to go past the wharf gates. Only one copy is necessary, as the form is made up in a stub book and the stub constitutes the record.

The merchandise has now been delivered to the consignee's agent and removed from the wharf.

Papers of the (Outbound) Receiving Clerk's Office.—The cargo from the *Saluda*, from Liverpool to Philadelphia, has now been discharged and delivered or otherwise disposed of. The *Saluda*



No. 50

INTERNATIONAL MERCANTILE MARINE LINES
405-409 BOURSE BUILDING

AMERICAN LINE.
ATLANTIC TRANSPORT LINE.
RED STAR LINE.

S. S. Saluda
Philadelphia, 6/18/19

Delivery Clerk:
Deliver to order of H. B. Vandegrift & Co.
the following merchandise from above-named Steamer at Pier { North 55 South

MARKS AND NUMBERS. QUANTITIES.

{DTC} 191/236 46 bales goat skins

INTERNATIONAL MERCANTILE MARINE CO.
Per

FIG. 18.—TRUCKMAN'S PASS TO PERMIT HIM TO REMOVE GOODS FROM THE WHARF.

must be enfreighted for the return trip. The outbound or eastbound freight department has been soliciting freight. Various records and forms are necessary at the main office and at the wharf

AMERICAN LINE
ATLANTIC TRANSPORT LINE

405-409 BOURSE BUILDING

RED STAR LINE
HOLLAND-AMERICA LINE

PHILADELPHIA Aug. 25, 1919.

Messrs. Caldwell & Company,
PHILADELPHIA.

Dear Sirs:—
Please deliver to S/S Saluda at Pier 55 South
Wharves on Tuesday, Aug. 26th, 1919 the following cargo under contract.

Yours truly,
WALTER T. ROACH.
Manager.

PROPERTY	DESTINATION	Contract	REMARKS
6 boxes iron car trucks	Liverpool		

FIG. 19.—DELIVERY NOTICE.

to keep track of this business. These papers pass through the office of the receiving clerk, to keep track of the freight and proper charges, and to the office of the pier superintendent, who is more directly concerned with the loading and stowing.

The Delivery Notice.—A patron of the line, let us say Caldwell & Company, has secured space for the shipment of six boxes of iron car trucks on the *Saluda*, sailing on or about August 28. When the outbound freight department learns from the wharf superintendent that the *Saluda* is light and will be loading on August 26, 27, 28, and 29, and will probably want to load these car trucks August 26 late or early August 27, there is then sent to the consignor (Caldwell & Company) a notice (Fig. 19) that reads:

Philadelphia, August 25.

MESSRS. CALDWELL & COMPANY,
Philadelphia.

DEAR SIRS:

Please deliver to *Saluda* at pier 55, South ....., on *Tuesday, August 26, 1919*, the following cargo under contract.

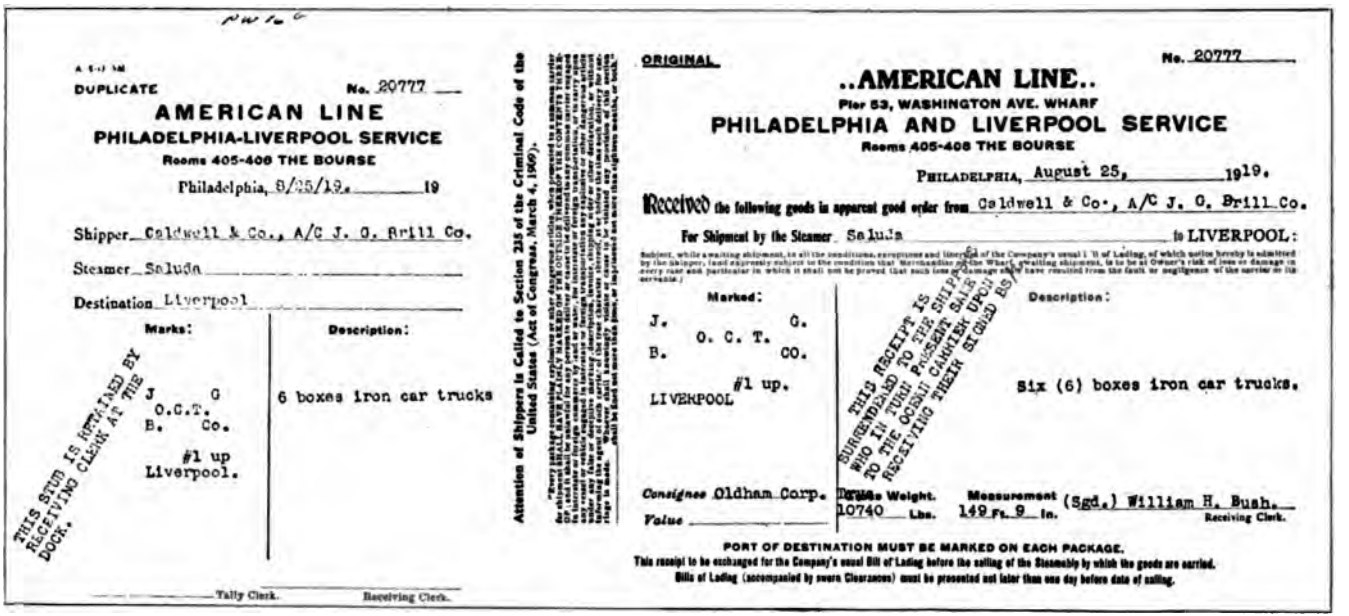
Yours truly,
WALTER T. ROACH, *Manager.*

There then follows a description of the goods. This form is made out in duplicate, the carbon copy being retained for the files.

With piers crowded it is very important that the time of delivery as indicated by advices from the wharves be observed accurately in order not to encumber the wharves by having the goods arrive too soon or delay loading by having them arrive too late.

Dock Receipt.—After the merchandise has arrived on the wharf the tallyman checks it, weighs and measures it, and enters the results on a tally list or slip (Fig. 6), addressed "to the receiving clerk," which he signs. This slip with the delivery order (Fig. 18) goes to the office of the receiving clerk, where the dock receipt clerk writes out the dock receipt (Fig. 20). The dock receipt is made out in duplicate, or check and stub, as in the sample. The original is given to the truckman or clerk accompanying the delivery and the duplicate is retained as a record. The dock receipt is an important paper, as it gives title to the goods until exchanged for the bill of lading, which must be done twenty-four hours before sailing date. Particular attention is called to the paragraph in fine print.

The words "Received the following goods in apparent good order" are also important. The receiving clerk will refuse to accept any merchandise that is not in good order so far as can be seen, because once loaded the line faces the question of claims for damage



DUPLICATE No. 20777

AMERICAN LINE
PHILADELPHIA-LIVERPOOL SERVICE
Rooms 405-406 THE BOURSE

Philadelphia, 8/25/19. 19

Shipper Caldwell & Co., A/C J. G. Brill Co.

Steamer Saluda

Destination Liverpool

Marks:	Description:
J G O.C.T. B. Co. #1 up Liverpool.	6 boxes iron car trucks

THIS STUB IS RETAINED BY RECEIVING CLERK AT THE DOCK.

Tally Clerk. Receiving Clerk.

Attention of Shippers is Called to Section 235 of the Criminal Code of the United States (Act of Congress, March 4, 1909).

ORIGINAL No. 20777

..AMERICAN LINE..
Pier 53, WASHINGTON AVE. WHARF
PHILADELPHIA AND LIVERPOOL SERVICE
Rooms 405-406 THE BOURSE

PHILADELPHIA, August 25, 1919.

Received the following goods in apparent good order from Caldwell & Co., A/C J. G. Brill Co.

For Shipment by the Steamer Saluda to LIVERPOOL:

Subject, while awaiting shipment, to all the conditions, exceptions and limitations of the Company's usual Bill of Lading, of which notice hereby is admitted by the Shipper, (and expressly subject to the condition that Merchandise on the Wharf, awaiting shipment, is to be at Owner's risk of loss or damage in every case and particular in which it shall not be proved that such loss or damage shall have resulted from the fault or negligence of the carrier or his servants.)

Marked:	Description:
J. G. O. C. T. B. CO. #1 up. LIVERPOOL	Six (6) boxes iron car trucks.

THIS RECEIPT IS SURRENDERED TO THE SHIPPER WHO IN TURN PRESENT SAME TO THE OCEAN CARRIER UPON RECEIVING THEIR STEAMSHIP BILL OF LADING

Consignee Oldham Corp.
Value

Gross Weight. 10740 Lbs.
Measurement 149 Ft. 9 In.

(Sgd.) William H. Bush.
Receiving Clerk.

PORT OF DESTINATION MUST BE MARKED ON EACH PACKAGE.
This receipt to be exchanged for the Company's usual Bill of Lading before the sailing of the Steamship by which the goods are carried.
Bills of Lading (accompanied by sworn Clearances) must be presented not later than one day before date of sailing.

FIG. 20.—DOCK RECEIPT.

and for insurance, the responsibility of the steamship company, and many vexing and troublesome questions that may mean loss and delay.

Record of Measurements.—The tally slip and delivery order go to the extension clerk in the receiving clerk's office, who converts the tallyman's long measurements of the cases into cubic measurement. Various forms are used to record the results and to forward them to the outbound freight department for exact calculation of the freight rate. The form illustrated in Figure 21 is used at New York but not used at Philadelphia. It shows, in the heading, the steamer, voyage, dock receipt number, date and shipper, and in columns it gives marks and numbers, number of packages in figures,

MEASUREMENTS.

*S. S.*_____ *Voy.*_____ *Receipt No.*_____

*N. Y.*_____ *191*____ *Shipper*_____

Marks and Nos.	P'k'gs	Measurements	Cube of One P'k'g	Cubic Contents	Weight	Remarks

FIG. 21.—MEASUREMENT RECORD.

measurements, cube of one package, cubic contents of shipment, weight and remarks, where is stated the number of cargo tons by weight or measurement as the case may be. The sheet should bear the name of the tallyman who measured and weighed the goods and be signed by the extension clerk. There may be two copies, one for the wharf and one for the outbound freight department, or the receiving clerk's record may be entered in a book.

The Cargo List or Sheet (Fig. 22).—As rapidly as merchandise is accepted for shipment and tonnage calculations are made, the cargo sheet clerk enters the items on a large form called "East Bound Cargo List, S. S....., Voyage....., Sailed.....19—" The sheets are numbered consecutively. The forms differ even

PW 18?

INTERNATIONAL MERCANTILE MARINE LINES

AMERICAN LINE

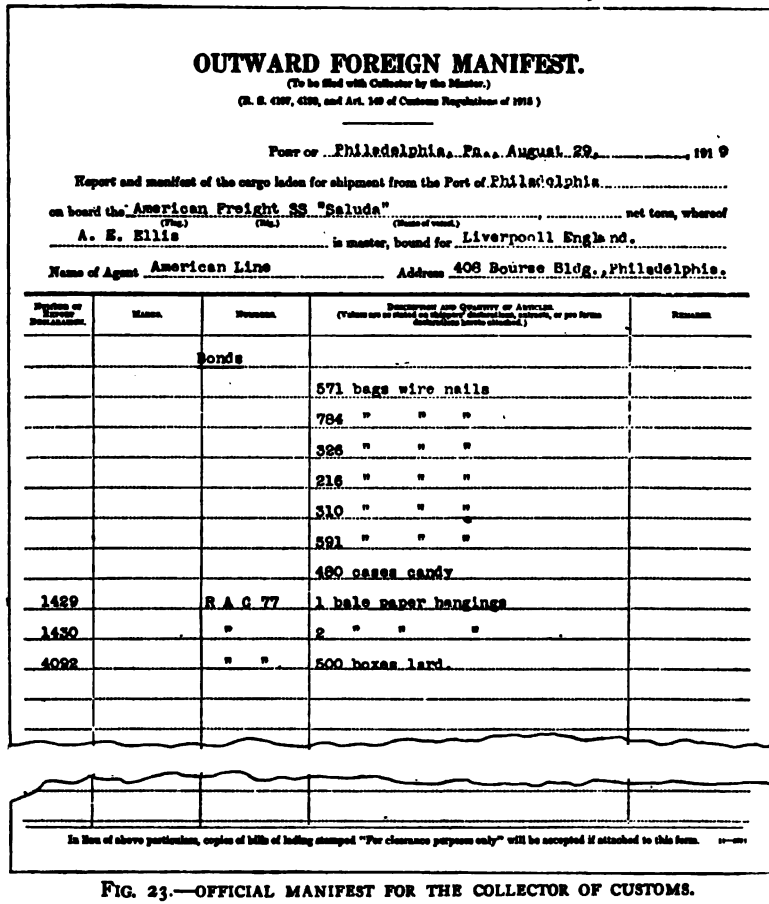
PHILADELPHIA LIVERPOOL SERVICE

Sheet No. EAST BOUND CARGO LIST S. S. Saluda Voy. SAILED 19

S.S. B/L	SHIPPER	Marks and Numbers	Initial	Thru B/L or Car No.	Packages and Contents	[illegible]	Weight	Measurement	U. S. License No.	U. S. Customs Declaration No.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	REMARKS
	E. F. Houghton & Co.	Edg. Vaughan Liverpool	Team	Team	89 bbls. lub. oil		45 tons	-									
	E. E. Delp Grain Co.	Malting Barley	Lighter	Girard Point	16,666 32/ Bus.												
	P. R. Mitchell Company		F.W.	7924	29 bales hair.			Wrappers torn									

FIG. 22.—CARGO LIST.

between offices of the same company, but the list must show all the details of all the shipments made on the vessel. There are columns in which are entered, across the page: the shipper, the consignee,



OUTWARD FOREIGN MANIFEST.

(To be filed with Collector by the Master.)

(R. S. 4197, 4198, and Art. 149 of Customs Regulations of 1915.)

Port of Philadelphia, Pa., August 29, 1919

Report and manifest of the cargo laden for shipment from the Port of Philadelphia

on board the American Freight SS "Saluda" (Flag.) (Rig.) (Name of vessel.), net tons, whereof

A. E. Ellis is master, bound for Liverpooll England.

Name of Agent American Line Address 408 Bourse Bldg., Philadelphia.

Number of Export Declaration.	Marks.	Numbers.	Description and Quantity of Articles. (Values are as stated on shippers' declarations, extracts, or pro forma declarations hereto attached.)	Remarks.
		Bonds		
			571 bags wire nails	
			784 " " "	
			326 " " "	
			216 " " "	
			310 " " "	
			591 " " "	
			480 cases candy	
1429		R A C 77	1 bale paper hangings	
1430		"	2 " " "	
4092		" "	500 boxes lard.	

In lieu of above particulars, copies of bills of lading stamped "For clearance purposes only" will be accepted if attached to this form.

FIG. 23.—OFFICIAL MANIFEST FOR THE COLLECTOR OF CUSTOMS.

marks and numbers, initial (that is, how received, by team, lighter, rail, etc.), number of through bill of lading or car number, kind of container, quantity and nature of the merchandise, weight, measurement, U. S. license number, U. S. Customs declaration number [2] and

[2] *See* "Paper Work in Export Trade," Miscellaneous Series No. 85 (sold by the Superintendent of Documents for $1), for a full description of the commercial papers connected with the shipment, including steamship bill of lading, etc.

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[3] *S*
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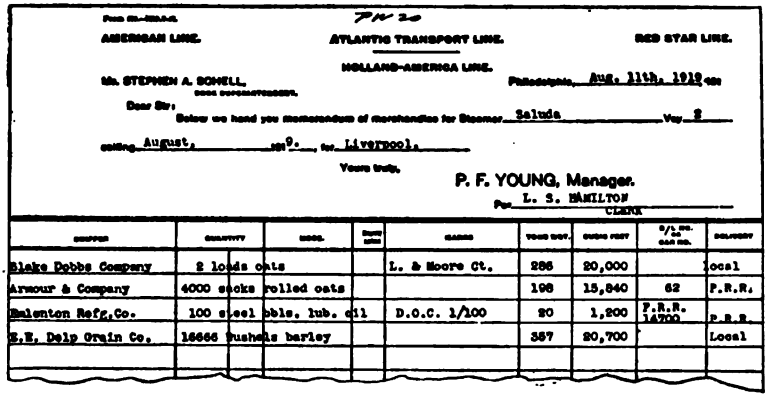
remarks. The information is received from the dock receipt stubs and the calculations of the extension clerk, with delivery notice and other papers that may have accumulated. Two copies are made, one is retained, the other goes to the main office. From it and the bills of lading is made out the ship's manifest.

The Ship's Freight Manifest.—Every ship by law must carry a complete and accurate list of all passengers and of all freight on the vessel on a particular voyage. It is necessary to have the mani-



AMERICAN LINE. ATLANTIC TRANSPORT LINE. RED STAR LINE.

HOLLAND-AMERICA LINE.

Mr. STEPHEN A. SCHELL, Philadelphia, Aug. 11th, 1919

Dear Sir,

Below we hand you memorandum of merchandise for Steamer Saluda Voy. 2

sailing August, 1919, for Liverpool.

Yours truly,

P. F. YOUNG, Manager.

Per L. S. HAMILTON CLERK

Blake Dobbs Company	2 loads oats			L. & Moore Ct.	286	20,000		local
Armour & Company	4000 sacks	rolled oats			198	15,840	62	P.R.R.
Edgerton Refg.Co.	100 steel	bbls. lub. oil		D.O.C. 1/100	20	1,200	P.R.R. 14700	P.R.R.
E.E. Delp Grain Co.	16666	bushels barley			387	20,700		Local

FIG. 24.—NOTICE OF SPACE SOLD.

fest complete and ready to be carried by the master as part of his ship's papers when the ship sails. Modern manifests are large sheets, made out on a wide-carriage typewriter. As many carbons as possible are made, as copies of the manifest go to numerous offices and files. The headings of the sheets and columns cover various entries, among which we find many old friends and some new items. (See folded insert.)

Outward Foreign Manifest.—The official form of manifest, which must be filed with the Collector of Customs by the Master of the Ship, for the customs (clearance office) is shown in Figure 23, to which may be attached copies of the ship's freight manifest. This form is made in triplicate: original and copies to the customhouse, which retains one, gives one to the master for his ship's papers, and one is retained by the line. The document must be sworn to.

Memorandum of Merchandise for the Wharf Superintendent.—As rapidly as space is sold for a certain steamer the wharf superin-

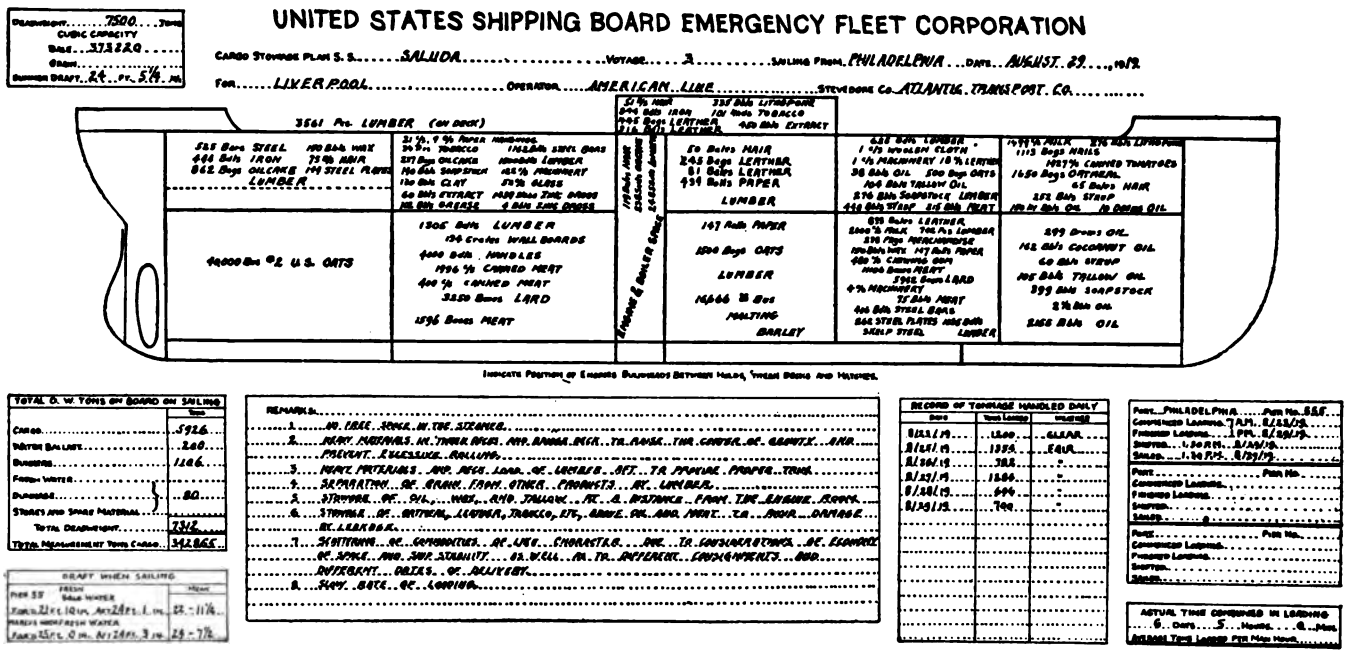
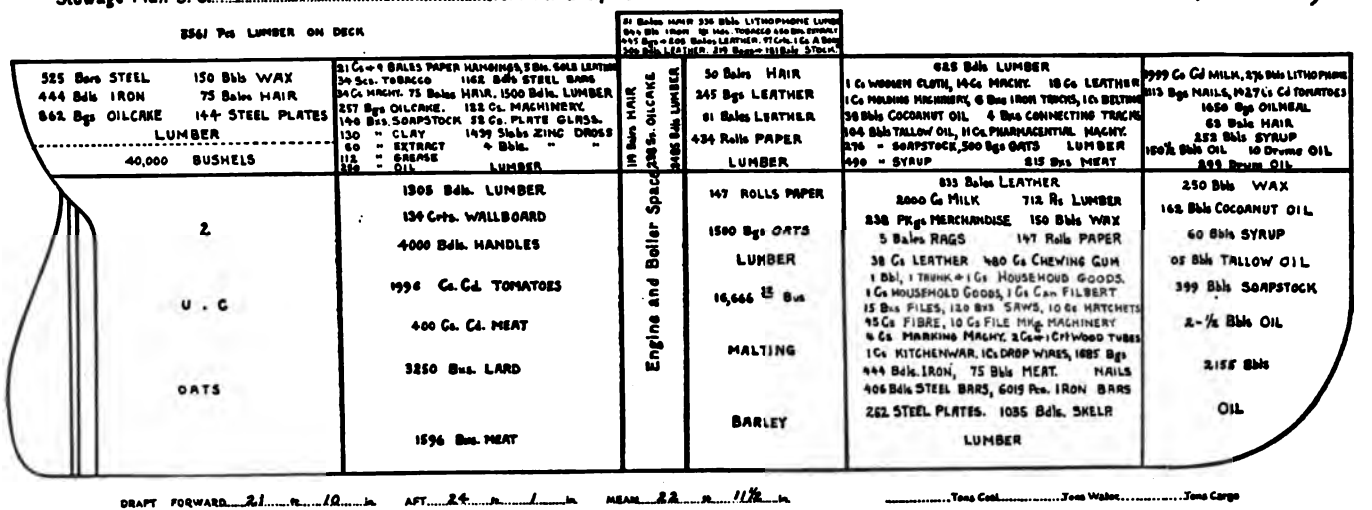


FIG. 25.—STOWAGE CHART.

THE ATLANTIC TRANSPORT COMPANY.

HEAVY MACHINERY IN 2ND TWEEN DECKS

Stowage Plan S. S. SALUDA from Philadelphia for LIVERPOOL Sailed AUGUST 29TH 1919.



DRAFT FORWARD 21 ft. 10 in. AFT 24 ft. 1 in. MEAN 22 ft. 11½ in. ..... Tons Coal ..... Tons Water ..... Tons Cargo

FIG. 26.—STOWAGE CHART.

tendent must be informed to enable him to plan the stowing. The sample notice (Fig. 24) is dated August 11, which is more than two weeks before the next sailing of the *Saluda*. The notice reads:

Philadelphia, August 11, 1919.

MR. STEPHEN A. SCHELL, Dock Superintendent.
DEAR SIR:

Below we hand you memorandum of merchandise for Steamer *Saluda*, Voyage 2, sailing August (date not known), 1919, for Liverpool.

Yours truly,
P. F. YOUNG, *Manager.*
Per L. S. HAMILTON, *Clerk.*

Then follows in ruled columns the name of the shipper, quantity and nature of the merchandise, marks, tons weight, and cubic feet (consignor's measurement), BL. or car No., delivery (if arriving locally) or by what railroad. This form is executed in triplicate or quadruplicate, original to the wharf, one copy retained, one to the railroad or roads concerned with the delivery of the freight to the pier.

The Stowage Plan.—The wharf superintendent allows the notices for the *Saluda* to accumulate in a file until shortly before actual stowing operations begin. The notices are then gone over and the ship is loaded on paper by writing the various shipments into the spaces on a ship's profile stowage chart, a rough fore-and-aft sectional outline of this ship or another of the same type (Figs. 25 and 26). As loading proceeds the items are checked off, and any changes due to unforeseen conditions are noted. This work is all done by the stowage clerk with the advice of the pier superintendent, chief stevedore, and ship's master. When lading is practically completed a fresh profile stowage plan is made with at least two carbon copies. The original is retained, one copy goes with the ship, and one to the customhouse with the manifest and other clearance papers. The final plan records the draft forward, aft, and mean; tons of coal, tons of water, tons of cargo, and sometimes average tonnage loaded per day, or hour, total time for loading, etc. Additional points concerning the stowage plan will be developed in later chapters.

CHAPTER VI

CARGO TRANSFER: I. METHODS OF TRANSFER[1]

Introductory Statement.—The term "transfer" is applied to the movement of freight between a ship and a wharf or another vessel. Hereafter, when the term "transfer movement" or "transfer" is used it means only the movement to or from a ship. The term "cargo-handling" is used sometimes to include transfer, but usually the term applies to the movement of goods about the wharves and warehouses, such as stacking, weighing, tiering, and all those processes where hands are laid on the various pieces of merchandise.

In loading and discharging vessels there are two distinct types of transfer: (1) transfer through side ports, and (2) transfer through deck hatches. Side-port transfer prevails in coastwise, river, and Great Lakes traffic, also in harbor craft, particularly with covered lighters. Side-port movement is similar to loading and unloading a box car.

Transfer through hatches is the prevailing type in all ocean-going vessels and in the great bulk-freight carriers that are so efficient on the Great Lakes. This transfer has its parallel in loading and unloading the gondola car in railroad freight service.

Transfer to the decks of ocean vessels may be by either the side-port or the deck-hatch method so far as the movement or trajectory is concerned. For instance, in the transfer to an open-deck lighter, such as most of those used about American harbors, it is immaterial whether the machinery used for hatch transfer deposits the goods from above or whether the machinery used for a side-port transfer runs on to the deck laterally. There is a parallel in transfer to or from the flat car in railroad service. It is also immaterial whether a crane or "winch and fall" deposits the package vertically from above or horizontally from the side. Therefore, open-deck loading may be by either the horizontal or the vertical method. These two

[1] By R. S. MacElwee.

methods of transfer are occupying the attention of all shipping men and terminal engineers and require most careful study.

The lack of standard practice is conspicuous in both cases. For many years past a storm of argument has raged concerning the relative merits of different types of transfer equipment. Some authorities have called the ship-loading methods used in the United States archaic. There is no doubt about the antiquity; sufficient historical evidence shows that the side-port method of transfer was used when the Phœnicians dominated the commerce of the Mediterranean, 800 to 1000 B. C.

The lack of standardization results in much inefficiency, confusion, and loss of time; therefore, greater expense, a drag on our commerce, and an element in the high cost of living.

The ultimate gain by standardization of methods and by the construction of piers properly planned for all the purposes to which a pier may be subjected would result in an enormous saving. The cost of handling, cost of transfer, and cost of holding the ship in port could be reduced materially.

Before proceeding to the study of the more universal methods of cargo transfer it is worth while to consider, for a few moments, some of the reasons for the great diversity in methods, and also some of the economic factors underlying the choice of equipment.

There are several reasons for the great diversity in handling methods. The principal one, of course, is that of inertia—the characteristic of the human mind to be diverted with difficulty from a habit once made. The superintendent of each pier or wharf has his own method of loading and unloading and enforces his ideas on the longshoremen working under him. The longshoremen, being a more or less floating collection, pick up various ideas in their career, and when one of them rises to fill the position of pier superintendent or boss stevedore he has accumulated his own opinions as to how transfer should be done and sees that his ideas are carried out on his own pier at least. Having derived his methods out of his own long experience, he is naturally very skeptical concerning new methods with which he is not familiar. The chief stevedore of a steamship line, or of a stevedore company, is so important to the working of the company that it hesitates to enforce upon him any new devices that do not appeal to his fancy.

As a result of this mental inertia, the methods actually employed

differ widely from one pier to another. There has been a storm of argument, which is still going on, concerning the relative merits of pier and quay systems, of wharf cranes and deck-winch systems, of continuous conveyors and rope falls, and all the other various combinations of "new-fangled" ideas that are meeting with opposition from the old crews. A conspicuous example of diversity of opinion is the argument that has been raging between the Society of Terminal Engineers, on the one hand, and the New York port authorities, on the other, concerning the type of construction that should be adopted for the Staten Island piers. The astounding thing has been the tenacity with which the so-called "old and experienced steamship men" have clung to the antiquated systems of pier construction and equipment that have grown up at the Port of New York and elsewhere because of certain historical conditions. This is an excellent example of inertia. The piers of New York were designed in their present form not because that was the most efficient form but because of certain limitations. The New York piers were built at the ends of the streets because the city had the right to the land under water at the extension of the streets. Therefore, the pier was limited to the width of the street. It was also limited in length by the army engineers because of certain rules regarding tidal prisms and other factors.

The steamship lines of New York have gotten on more or less satisfactorily in spite of the difficulties of the specified layout of their piers, and they have come to believe that the only way to operate a pier is to operate it exactly in the way that they have been forced to adopt by circumstances. Like the prisoner who had slept on his hard couch for ten years and, therefore, could not become accustomed to a hair mattress, so have many steamship companies and their superintendents, stevedores, and longshoremen become so accustomed to the cramped quarters of the inadequate New York piers that they cannot see the comforts of a new order of things that would follow a liberation from the enforced confinement imposed by the historical background of the Manhattan water front.

It is not astonishing that the old line steamship men have been cramped like a Chinese lady's foot in their attitude toward water-front improvement. Even very progressive and enlightened harbor engineers have maintained that the New York pier system is superior to some of the most modern and efficient European systems that were

built according to well thought-out plans and not forced into a straight-jacket of existing circumstances.[2]

Striking examples of inertia in freight-handling methods may be seen along the newly finished New York State Barge Canal, where modern equipment is allowed to stand idle while methods of thirty years ago are continued in practice. The old boatmen became so accustomed to their methods of transfer from canal barge to shore that it is an astounding fact that the newly equipped terminals are hardly used. At many of the barge canal terminals the State of New York has provided a locomotive steam crane that operates on flat wheels and can proceed to any point along the wharf. This steam crane is very easily operated and can handle rapidly light and heavy drafts from the barge to the shore. Nevertheless, the boatmen will allow this crane to stand with steam up—the use of it costing only a nominal fee—and will proceed with their old methods. A common type in use is the horse-and-fall rig, or "horse elevator." A mast and boom is rigged on shore with a simple block and tackle; a fall line from the hook passes over a pulley at the end of the boom and to the foot of the mast. At the other end of the line is attached a whiffle tree to which a horse or mule is hitched. The hook is attached to the draft, the signalman calls out, and the driver and the horse walk away from the base of the mast and lift the draft to above the level of the deck of the canal boat. It is then swung back and forth a few times and at the right moment "Let go" is called and the draft is dropped on to the deck. It is then trundled with hand trucks across a gangplank to the shore, or it may be swung across from the edge of the boat to the edge of the wharf. The boatman will lose an hour going down to a livery stable and getting a horse to enact this antiquated performance of unloading when a modern power crane, with steam up, will stand by unused. Iron ore and coal were handled on the Great Lakes in this same way thirty years ago at a cost of 50 to 60 cents a ton, and at a speed of 150 tons a day. It is now handled by mechanical means, 1,000 tons an hour, at a cost of 2 or 3 cents a ton. It seems impossible to believe that one may go to the modern port of Philadelphia and see the horse elevator unloading alongside a modern pier.

The problem of selecting wharf equipment is not simple. No

[2] For example, see the report on "New York Water Terminal and Transfer Facilities," H. of R. Doc. No. 226, 63rd Congress, 1st Session, 1913.

single method is applicable to all commodities, vessels, piers, and ports. The tendency is to ignore some of the many variables that are found in the problem.

A quadratic equation with five variables cannot be solved unless four of the variables are held constant, while a value is obtained for the fifth, the process being repeated until values are obtained for all. But many port authorities, terminal engineers, and shipping men have forgotten this algebraic principle and jumped to a solution when having the value of one variable only. To solve the problem for one port and one type of merchandise alone is an enormous piece of work, and one that has never been adequately undertaken.[3]

The most complete study of the subject is that just completed by the New York–New Jersey Port and Harbor Commission under Mr. B. F. Cresson, Jr. It employed a large force of men and took two years for the work. Its conclusions are extremely valuable. The results obtained by this very extensive analysis of port facilities should be an aid to all water-front problems.

The questions of cargo transfer and handling and wharf layout must be solved for each particular case. Even the horse elevator of the old canal boatmen has its place. One may pass by and remark, How is it possible that these antiquated methods are being used? However, by a close observation of the facts in the case one may find that the horse and fall is the cheapest way to unload that barge under the circumstances, even if wages for longshoremen are $7 a day. In the handling and transfer of cargo or the handling of any material one is always confronted with the problem of "earning the overhead." For any given mechanical equipment there must be sufficient cargo handled per year to make the saving per ton pay for the expense of installing the equipment. Two $25,000 cranes, or a total expense for cranes of $50,000, on a wharf where they will transfer only 100,000 tons of freight a year would mean an initial cost of 50 cents for every ton of freight handled. Figuring depreciation at 20 per cent, which is, of course, very liberal, plus the interest on the investment and plus the cost of operation, it may be found that it would be cheaper to handle freight at the wharf in question by the old horse-elevator method.

In proceeding to the study of both side-port and deck-hatch

[3] T. R. Taylor, *Stowage of Ship Cargoes.*

methods of transfer it is necessary to keep in mind the essential fact that each case must be solved on its merits. The main energy of the study will be devoted to things as they are, rather than to possible improvements. However, the possibility of improvement must never be lost to view.

Transfer through Side Ports

The prevailing practice in freight transfer on harbor lighters and on coastwise, river, and Great Lakes package-freight vessels is through a side port or an opening in the side of the vessel on to its main deck. Side-port vessels have a shallow hold, and the volume of freight carried in the hold is not comparable in amount with that carried in the hold of an ocean-going vessel. Particularly in the shallow-draft steamboats used in river navigation there is little or no cargo space in the hold. The main object in carrying cargo on the deck is to afford rapid and easy transfer of small quantities of merchandise at ports of call along the river or lake in a port-to-port service. The system of deck loads has certain advantages for this kind of service.

Transfer by Unassisted Man Power.—The practice of carrying freight on the backs or shoulders or heads of persons is called "steamboating." It is confined largely to rivers where the vessels and the packages of freight are small. Even in these places it is being eliminated by more improved methods. It has been common to New Orleans and to the levees of the Mississippi River where colored longshoremen carry freight on their backs, heads, or shoulders. In many parts of the world vessels are still loaded by a great mass of unassisted man power just as in the days of the Egyptians and the Phœnicians. In some parts of the West Indies vessels are bunkered by native women, who carry small baskets of coal on their heads in a long procession. At New Orleans the ruling of the National Adjustment Commission is: "The practice of 'steamboating,' or carrying freight in and out of ships or in and out of cars, will be reduced to the smallest practical minimum." [4]

Transfer by Hand Truck.—The common method throughout the United States and many other countries in all side-port load-

[4] Coastwise Longshoremen Award at New Orleans, October 21, 1918, Nat. Adj. Com., 1918, 126. *See also* Thomas R. Taylor, *Stowage of Ship Cargoes.*

ing and unloading is the use of the hand truck. This is a very simple operation, particularly along canals and on the Great Lakes, where there is little change in the water level due to rise and fall of the river or tide. The system is exactly the same as that employed in loading a box car. A gangplank is laid between the wharf and the deck of the vessel, over which the longshoremen push hand trucks with their loads.

On the Great Lakes the longshoremen are so jealous of the privilege of pushing hand trucks back and forth that they fight individually and as a union any efforts to introduce labor-saving equipment. The longshoremen at the head of the Lakes and at Buffalo will carry only three bags of flour on a hand truck at one time; and they refuse to allow the transfer movement to be assisted by mechanical means. A barge line at Buffalo installed a crane to transfer merchandise across railroad tracks to a freight shed, but the unions forced the abandonment of the crane and the bridging over of the tracks. The most simple mechanical conveyor for side-port transfer is the continuous chain and lug system, or Reno conveyor. This consists of an endless chain run over sprocket wheels and driven by an electric motor. Lugs protruding from the chain at intervals engage the bar or axle of a hand truck and pull the hand truck along. This mechanism has been particularly helpful at Boston, New Orleans and other places where there is a wide range in the water level. It is obvious that if the hand-truck load is helped up the incline of the gangplank in such a manner that the longshoreman has only to move himself and keep the hand truck steady, a greater dispatch is afforded.

Hand-truck Transfer and Loose-pulley Fall.—Package-freight vessels on the Great Lakes carry from four to five thousand tons of freight, partly on the deck and partly in the hold. In loading bags of flour to the hold of the vessel the longshoremen pass in procession across the gangplank onto the main deck and up to the edge of the hatch, tip the hand truck over and the flour bags drop into the hold. As the distance is only 12 or 13 or 14 feet, the fall is not serious. After dumping a truckload the longshoreman proceeds with his empty truck around the hatch, out over another gangplank, and back to the loading point. To hoist the hold cargo to the deck for discharging the lake vessels have developed a loose pulley and fall. Power is supplied through an ordinary

shop transmission shaft driven from the engine room. At each hatch there is a fixed and a loose pulley with a belt running to a small wooden drum over the hatch. The belt is shifted from one pulley to the other by a lever, exactly as in a machine shop. The drum winds or unwinds a pendent—a fall rope with a hook. Discharging is performed as follows: The fall rope having been lowered into the hold and hooked to a draft of bags of flour, for instance, a signal is given to the man at the lever, who throws the belt from the loose pulley to the fixed pulley. The load is lifted to above the level of the deck, and when the signalman indicates to let go, the belt is shifted from the fixed pulley back to the loose pulley at the same time that the draft is swung sidewise on to the deck. It is unhooked, the hook falls into the hold for the next draft, while the longshoremen pick up the bags of flour, load them on trucks, and push them ashore across the gangplank. The motion is a positive and direct one and works very well.

Transfer by Mechanical Conveyors.—Considerable progress has been made in the introduction of mechanical belt conveyors for side-port transfer. These conveyors are moving gangplanks that make unnecessary the travel of the stevedore with his hand truck from the main deck of the vessel to the deck of the wharf. The difference in level is not important within wide limits, as the conveyors can be fitted with cleats that make it possible to carry bags, barrels, and small boxes to an angle of 30 degrees or more from the horizontal. For example: In discharging flour in bags as just described, when the bags are landed on the main deck from the loose-pulley fall, instead of being loaded on to a hand truck and taken across the gangplank to the shore by man power, the bags are thrown on to the constantly moving belt conveyor. The conveyor will carry them across to the longshoremen inside the warehouse or transit shed, where the bags may be stacked or tiered by tiering machinery. These portable horizontal conveyors are gaining in popularity. An excellent example is to be found on the New York State Barge Canal at Schenectady, where the General Electric Company uses one continuously for loading and unloading canal barges.

The gravity conveyor or roller gangplank is worthy of notice. For transfer from a higher to a slightly lower level it is possible to use a roller gangplank without power. This is a very simple device consisting of a frame with rollers between them. The rollers are

slightly concave to direct the package to the middle of the conveyor and they turn on ball-bearings. A box placed upon one end of the conveyor runs by gravity down to the other end, where it is picked up by the longshoremen and tiered, stowed, or otherwise handled. All these devices may be used in combination, and it depends upon the ingenuity, enlightenment, and alertness of the wharf superintendent and boss stevedore in each case to utilize such simple or elaborate equipment as is justified by the amount of cargo to be handled and the saving that could be accomplished thereby.

Side-port loading and unloading is bound to disappear before the mechanical transfer age. In certain services, however, we may expect a certain amount of side-port transfer for many years to come.

Transfer through Over-all Hatches

A very large proportion of all ocean-going freight is transferred through deck hatches, and the methods in use must be carefully understood. These methods may be divided into several groups, as follows:[5]

1. Ship's tackle used exclusively.
   - *a.* One winch and one boom and skids or planks.
   - *b.* Two winches and two booms.
2. Ship's tackle used in connection with cargo masts and pier winches.
3. Cranes on the wharf.
4. Floating cranes (particularly for heavy lifts).
5. Specialized equipment.

As ocean carriers must be prepared to go into ports of every degree of development, or lack of development, they must also be prepared to get along without any port facilities whatsoever except the lighters or small boats that may come alongside. For this reason all modern cargo carriers have a full equipment of booms and deck winches for transferring cargo. As the transfer of merchandise to and from the ship is done at the expense and responsibility of the

[5] MacElwee, *Ports and Terminal Facilities.* McGraw-Hill Book Co., 1918. Taylor, *Stowage of Ship Cargoes,* U. S. Bureau of For. & Dom. Com., 1920.

ship, there has been a natural development of the transfer machinery on the ship. Bills of lading include, in the freight rate, transfer from alongside (within reach of the ship's sling) to the hold of the vessel and stowage therein of all usual cargo except packages of greater weight than 2,000 pounds, or of such form as not to be handled readily by the ship's equipment. Where there are pieces of cargo greater than 2,000 pounds, special arrangements are made and charges fixed accordingly. In the considerations that are to follow there is in mind miscellaneous cargo in packages of less than 2,000 pounds; this excludes for the present all the very heavy packages and also bulk cargo.

Prevailing American System.—Inasmuch as the prevailing American shipping practice puts the burden of transfer upon the ship, there have been developed practically no devices or mechanical equipment on the wharf itself, other than the transit shed—a covering to shelter the merchandise. The interest in the study of wharf administration by aspiring young shipping men centers in the prevailing practices with which they will be confronted, rather than in changes advocated in many quarters.

The ship's equipment consists usually of deck winches run by steam from the boiler room and of short stubby masts with a number of booms fitted with blocks and ropes or cables, through which the energy of the winches is brought to bear on the merchandise. Winches will be taken up in detail later, but the "business end" of the winch is a drum and a "drum end," sometimes called "winch head," or "drum-shaft extension." This is a steel spool at the end of the axle or shaft of the drum and free at one end. Lines are fastened to the drum and are wound up thereon and unwound. The drum end with the proper skill of the longshoremen gives greater flexibility. The drum-end man is able to take a few turns of rope around the spool, looping it in such a manner that he can maintain the proper degree of bite or friction and control the speed of the fall by the amount of slip. The line passes over blocks at the end of the boom. For additional lifting power double and triple blocks are sometimes used. With light drafts of about 1,000 to 2,000 pounds a simple block is used to obtain greater speed. A hatch is an opening which is boarded over at each deck it passes through. The hatch cover below the top deck is called the ceiling. Hatch openings when cleared extend from the deck of the vessel through to the hold. The planks

under the hatch cover and in each deck rest upon steel stringers called "strongbacks" that run either athwartship or fore-and-aft across the opening. The hatch opening on the top deck should be fitted with a coaming 2½ to 3 feet high to prevent longshoremen from slipping into the hold.

To clear a hatch consists in rolling back the tarpaulin that covers the planks and removing the planks by hand and setting them to one side. By means of the ship's tackle the beams or "strongbacks" are lifted out and put at one side. If the hatch is very large and the packages to be loaded are small only one part of the hatch needs to be cleared. Usually where the packages are small and the hatch large the entire hatch is cleared and two sets of tackle are used with two gangs of men and two falls.

Brief Description of Three Common Methods.—The three simplest methods of transfer by ship's winches are: (1) a single winch with a single boom and fall, and a skid extending to the wharf; (2) use of two deck winches and two booms, one extending over the hatch with the up-and-down fall, the other extending over the ship's side and carrying the burton fall, that is, the "fall-and-burton" system; (3) a combination of the fall-and-burton system in which the burton boom instead of a cargo mast on the wharf is used. In all of these cases, if the deck winch is out of order or if so desired, portable winches on the wharves may be used for operating the falls.

Single Boom and Up-and-Down Fall with a Skid.—The simplest method, though not used to any great extent at the present time, is by use of a single boom and skid. One cargo boom is placed extending over the hatch opening. A fall through a block on this boom is operated by a single deck winch. One end of the fall is wound on the winch drum; at the other end is a hook that must be heavy enough to draw down the empty rope or weighted for that purpose. The draft is brought to the edge of the wharf. From the wharf to the deck of the ship and from the deck coaming to the hatch coaming extend heavy planks. The longshoreman carries the empty hook to the edge of the deck and throws it on to the wharf where it is hooked on to the draft. The winch is started and slides or drags the draft along the gangplank skid. When the load clears the ship's side it swings over the hatch by gravity. The stevedore, by means of a guide line that he dexterously throws around the fall rope just above the hook, prevents the draft from swinging athwartship and banging

against the boards or the coamings on the opposite side of the hatch (see Fig. 27).

The draft being brought to rest above the hatch is then lowered, by throwing out the lines on the drum end or reversing the deck winch, until it reaches the point above the floor of the hold when "stop" is signaled. It is then lowered slowly to the hold, being swung to one side or the other as desired. When the hook is liberated the stevedore snaps the hoisting line and throws the hook dexterously over the side of the ship on to the wharf where it is ready for the next load. With practice considerable speed may be developed in handling drafts in this way.

FIG. 27.—STOPPING THE SWING WHEN LOADING WITH SINGLE BOOM AND SKID. (*Courtesy of Lidgerwood.*)

The Burton-and-Fall or Yard-and-Stay System.—In spite of the possible damage to the cargo by the single fall and skid method just described, it is used considerably for loading. When it comes to unloading, however, the difficulty of bringing the loaded draft athwartship in order to lower it overside is apparent. When loading it swings by gravity over the hatch, but when unloading the drag that is necessary to carry the load athwartship and then to lower it to the lighter or the pier deck is considerable. The burton-and-fall or two-mast system, has therefore been developed and is common practice for all ship's tackle rigs (see Fig. 28).

In analyzing the movement of a draft of merchandise between a

wharf and hold we find the following: (1) elevation, a vertical movement from a wharf to a high position to clear the bulwark of the vessel; (2) a horizontal movement athwartship to the middle of the hatch; (3) a vertical movement down to the point of deposit in the vessel. In unloading, these three are reversed. This analysis discloses that there are up-and-down movements at two points, one above

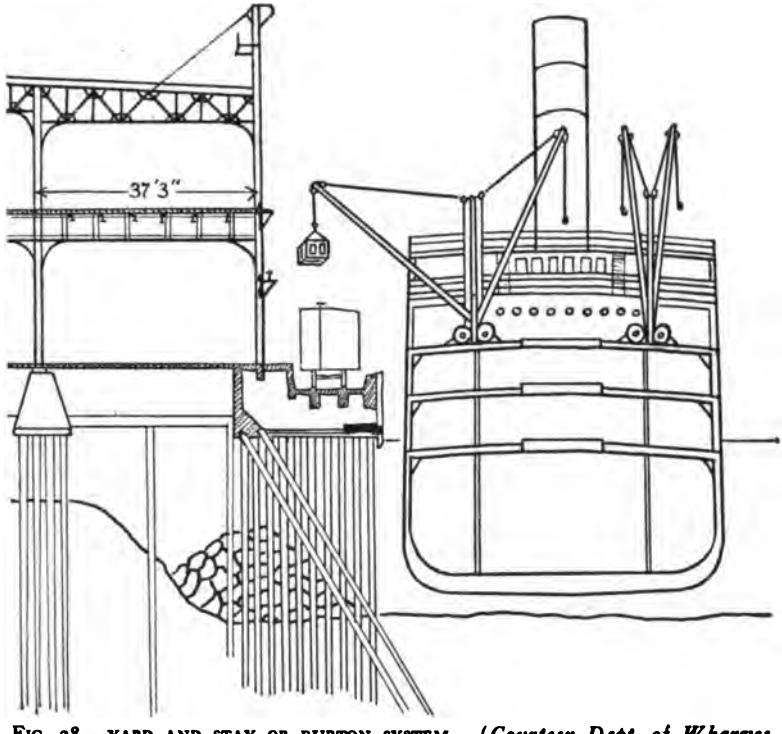


FIG. 28.—YARD AND STAY OR BURTON SYSTEM. (*Courtesy Dept. of Wharves, Docks and Ferries, Philadelphia.*)

the hold, and one above the wharf, and a horizontal movement to cover the distance between these two vertical movements. In practice the movements are not sharply defined but merge one into the other, depending on the skill of the longshoremen running the winches. In order to accomplish the three movements with ship's tackle the two-boom and two-winch system have become general, in which there are two whips or ropes attached to a single hook, but operated by separate winches over separate booms.

A glance at any of the modern cargo carriers discloses the short,

stubby mast with a forest of booms built around the base of it. A mast with its booms, located between two hatches, is surrounded usually by four donkey engines or winches. The location of the four winches at the base of one of these masts of a modern cargo carrier is shown in Figure 29. This illustration shows the instal-

FIG. 29.—MAST, BOOMS AND WINCHES BETWEEN TWO HATCHES.
(*Courtesy of Lidgerwood.*)

lation of four single friction drum winches grouped around the mast, two winches for each hatch.

Two booms and two winches are generally used at each hatch; one boom is swung over the center of the hatch carrying the up-and-down fall and hook, and the other is swung outboard from the vessel in order to reach clear of the vessel's side and over the wharf. Over this boom the second winch operates the so-called "burton fall" or the "outboard fall." The terms given to these two lines or whips are not standardized, but for the uses here it should be remembered that the outboard line is called "the burton" and the hatch line is called "the fall." One must not be confused by the fact that the outboard line is sometimes called the burton fall to distinguish it from the up-and-down or hatch fall. The movements of the winches in the two-boom system with two winches may be analyzed as follows in transferring a draft from the deck of a lighter or the wharf to the hold of the ship: (1) The far-side winch, operating the fall, has paid out the

rope that hangs over the rail of the vessel; the near winch, operating the burton, starts to lift the cargo and lifts it to a point sufficiently high to clear obstacles such as the bulwark rail and the hatch coamings; (2) the far-side winch begins to pull on the fall rope, thus drawing the load athwartship; (3) the burton winch lets go gradually, thus slacking off the fall until it comes to rest above the hatch; (4) the fall now lowers the draft into the hold, trailing the slack burton rope after it.

The burton-and-fall two-boom and two-winch system is so rapid, direct, and efficient that there is plenty of ground for debate as to the superiority of wharf cranes, inasmuch as vessels must be prepared to meet all difficulties and must, therefore, have the necessary deck-hoisting equipment with them at all times. The system, although it requires two winch operators, is very direct; the movement across the ship and into the hold being quite rapid. The rapidity of this "diabolo" movement—it much resembles the old game of diabolo where the little spool is kept spinning on a string between two sticks—depends largely upon the skill of the drum-end man. He deserves particular consideration.

The Drum-end Man.—As mentioned in passing, and as will be described in detail under the description of deck winches in particular, a deck winch consists of a drum on which a rope is wound up and paid out, and a spool fastened to the extended axis of the drum, known as the "gypsy head," "nigger head" or "drum end." This spool extending out from the side of the winch should be from about 16 inches to about 24 inches in diameter. Its use is very popular, but the success of its use depends entirely upon the skill of the drum-end man (see Fig. 30).

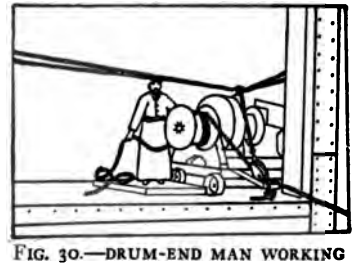


FIG. 30.—DRUM-END MAN WORKING A DOCK WINCH.

The work of the drum-end man is difficult to learn, and unless there is proficiency it is less speedy than a drum. The fall runs from the block on the boom to the drum end, around which a few loose turns of the rope are taken and a length of it is coiled up behind the drum-end man. The nice adjustment between the burton lift and the fall lift, the tightening of one whip and the slacking of the other, and the lifting of one and the lowering away of the other,

is controlled by two individuals, and their close harmony in working together depends upon their skill in keeping a flexible movement, by means of the amount of pressure or "bite" of the rope maintained by the drum-end man.

The fall rope is wound around the drum end a number of times according to the work it has to do. A first coil must be put on with great care, for if it is put on with a kink it will reduce the friction and in lifting a heavy draft the rope may be cut. It must also be wound on the drum end in the direction in which the drum revolves, otherwise the fall will unwind itself, and it must be wound from the left end of the spool on the right-hand winch, and from the right end of the spool on the left-hand winch. After the rope is looped correctly around the drum end, the drum-end man regulates the "strike" and the "up-and-down travel" of the draft by causing the coils to slip or to bite on the spool. He accomplishes this by standing behind the winch with the loose end of the fall in his hands and pulling just enough to get the proper friction to take up the slack or lift the load, or he lets the rope slide through his hands just enough to lower the burden into the hold. The drum-end man usually wears heavy gloves to prevent the rope from burning his hands.

The speed of raising or lowering cargo with drum ends is limited by the skill of the stevedore taking up the slack end of the fall and the quality of his judgment in maintaining the correct bite for the various sizes and positions of the draft. It seldom exceeds 170 feet per minute. As the speed depends largely upon the work of the drum-end man operating, the matter of fatigue plays a conspicuous part. The stevedore fresh in the morning may hoist at the rate of 175 or 180 feet a minute, but as the afternoon wanes he slows up to about 125 or 130 feet. In crane operation, where there is practically no physical exertion and where the operation is more mechanical and less dependent upon personal skill, the same rate of speed is maintained throughout the day.

It is believed that greater hoisting speed could be accomplished and maintained by using winches with fixed wire rope wound around the drum and a speed averaging 325 feet a minute attained. A standard type of ship's winch reported by the manufacturers has three-quarter inch rope to hoist loads of one-half ton 100 feet at a speed of 400 feet per minute; 3-ton loads at 200 feet per minute; 5-ton loads at 120 feet per minute; and 8-ton loads at reduced speed, the full rated

capacity being 10,000 pounds maximum. However this may be, the fact still outstands that in the transfer movement in American ports to-day the drum-end man is a very important factor.

A provisional boom or yard arm is sometimes set near the bulwark on the deck of the ship where the ship does not carry sufficient booms. Older vessels and some smaller vessels, sailing ships, and others are not sufficiently equipped with cargo booms, and it is necessary to set a second boom to handle the burton in the yard-and-stay or burton-and-fall method as described above.

Many of the modern cargo carriers are equipped with *two cargo masts* stepped off center instead of one stepped midships. The masts off center are used particularly on colliers and specially designed ore carriers. Those in the Swedish and Spanish iron-ore trade to Rotterdam and several United States Navy colliers are examples. Many of the United States Shipping Board vessels were built with double masts (Fig. 28). The object of the double mast is to divide the rigs as between port and starboard in order to have a rig for the wharf side and another for the water side to handle goods brought alongside by lighter or to work from lighters and barges on both beams when anchored "in stream" or at mooring posts.

Cargo Mast.—A cargo mast is a part of the equipment of a wharf or pier; its object is to facilitate the burton-and-fall two-hoist systems that have just been described and liberate for other uses the ship's burton, or outboard boom, and the winch necessary to operate it. With only two winches at the hatch it is possible to operate only one burton and fall, that is, to keep only one hook in movement. Burtoning to a cargo mast and operating the burton fall by means of a pier winch liberates one winch and the hook and the tackle aboard ship for other purposes, particularly for far-side or water-delivery freight. It very often happens that two pier winches are used to operate both the fall and the burton for the shore freight, while the deck winches are both used to operate the burton and fall booms to take cargo overside from lighters. In this case the two pier winches with the aid of one of the ship's booms are performing the same services that would be performed by a crane. This is the only way to use two forces or gangs to a hatch and work both sides of the ship at the same time.

The cargo masts with which modern piers are provided are of several types. The oldest type consists of strong, wooden masts

set near the edge of the pier and connected with one another near their peak by a stay; to the stay are fixed stirrups to which blocks may be attached. A later type was developed by connecting the projections of the pier column by a rope stay. The most modern type, however, replaces the stay by a steel beam.[6]

The type of modern cargo mast now in general use is seen from

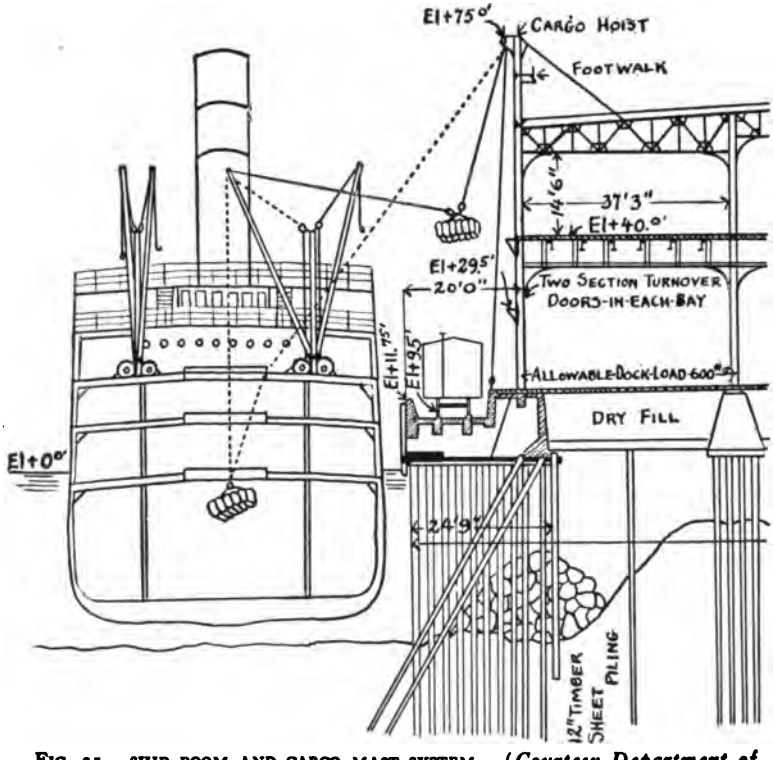


FIG. 31.—SHIP BOOM AND CARGO MAST SYSTEM. (*Courtesy Department of Wharves, Docks and Ferries, Philadelphia.*)

the accompanying illustration (Fig. 31). The pier-shed columns are extended to the height of 75 or 80 feet above mean low water. These vertical beams are secured by horizontal beams with cross bracing. There is also a footwalk along the entire structure. From this footwalk it is possible to secure the stirrup in the horizontal beams to which the blocks are attached; the whip is attached to the

[6] C. W. Staniford, "New Cargo Masts Developed for New York City Piers." *Engineering News Record*, Vol. LXXVIII (1917), 453, 454.

block through which the burton rope passes. The horizontal beam is provided with holes at about 2 to 3 feet centers. It is only necessary to pass a single bolt through one of these holes and secure it with a nut on the end. A "close-up" of two burton blocks at the cargo masts at one of the Chelsea piers at New York will illustrate this simple process (see Fig. 32).

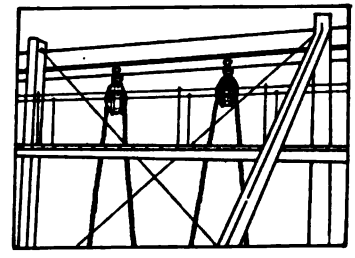


FIG. 32.—BLOCKS AND SHACKLES ATTACHED TO CARGO MAST EQUIPMENT, CHELSEA PIERS, N Y.

In the description of operation that follows it will be understood that unless otherwise stated the cargo-mast burton-and-fall system will be taken for granted.

CHAPTER VII

CARGO TRANSFER: II. CARGO WINCHES AND SIGNALING[1]

The various types of deck and dock winches for various kinds of work should receive careful consideration and their operation and the principles involved in their care should be thoroughly understood. It is believed that, with the work to be done by the various types of transfer equipment clearly in mind, a better appreciation of the importance of the winch may be gained in preparation for a more careful study of the detailed operations of cargo transfer.

Standard Practice

Standard specifications for cargo-handling deck winches usually provide for a set of four winches for each mast, or two for each hatch. When there is no mast stepped between the hatches, but the two hatches are practically continuous, the two pairs of winches are placed at opposite ends of the hatches.

Rigging.—The rigging in standard practice (Figs. 33 and 34) fixes one boom over the hatch, and the other over the side of the vessel, both whips being permanently attached to a single hook, forming what is called the yard-and-stay or the burton method, described in detail in the preceding chapter. The winches are installed in such a manner that one winch runner or operator standing between them can see down into the hatch and operate a winch with each hand. Although entirely dependent upon the signalman (see below) for the position of the hook overside, or outboard, he is in full control of the operations of the draft into and out of the hold.

These winches are very easy to operate, since each is controlled by a single lever operating the reverse valve, with the rope leading off the top of the drum. This one lever is moved up or down according as the draft is to be lifted or lowered, that is, the control lever is moved in the direction that the draft is to travel. Moreover, the

[1] By R. S. MacElwee.

FIG. 33.—THE WHIP. This leads off the top of the drum, through a block fastened to the deck, and thence through the block at the peak of the boom—light duty rig. (*Courtesy Lidgerwood.*)

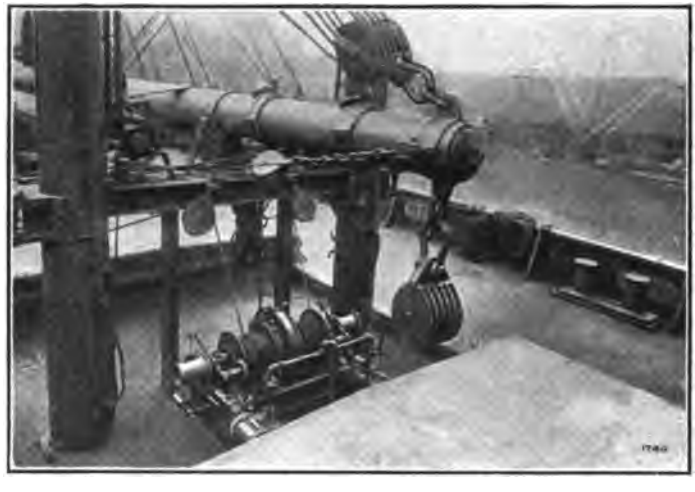


FIG. 34.—BLOCKS AT THE PEAK OF A BOOM. Upper one for lowering and raising the boom; lower one (hanging) through which the whips travel. This boom is stored and not in action—heavy duty rig. (*Courtesy Lidgerwood.*)

speed of the winch is determined by the amount the lever is moved. For these reasons one inexperienced man can quickly learn to operate simultaneously the two winches at a hatch.

The efficiency of a dock winch is determined not so much by its speed as by its dependability. The dependability in turn is determined largely by the stanchness of its construction to resist the "working" of a vessel tossed about at sea and by its simplicity in the care and operation that must be left largely to longshoremen.

Control.—Modern steam winches have throttle control. As winches are operated by longshoremen in every port and not by a member of the ship's crew, the simplicity and reliability of the winch are of the first importance. A demonstration for the type of winch control that should be general is indicated by the following test at a factory. A day laborer handling a wheelbarrow who had never operated any kind of machine was chosen for this test and was asked to hoist and lower a 500-pound load. He was instructed as follows: Lift the lever to hoist the load; lower the lever to lower the load; put the lever in its first position, or simple position, with foot on the brake to rest or to hold the load. After several attempts this laborer lifted the draft 25 or 30 feet safely, rested it at will, and lowered it to the ground without a jolt.

Capacity.—There has been a consistent increase in the capacity and lifting power of ship's deck winches for handling cargo. Modern ships are equipped with steam or electric winches having heavy gears, and with booms, cables, blocks, falls, etc., of large capacity. The rigs are now capable of lifting loads of as much as 5 tons; by combining two lifts, even heavier drafts may be handled. As drafts usually run from 1,000 to 1,500 pounds, their greater capacity is for reserve power and for emergency use. By not overworking or overloading winches their life is prolonged as with any other machine.

Kinds of Winches

Right-hand and Left-hand Winches.—The accompanying view, Figure 35, looking vertically upon the deck from the mast will aid in understanding the general nature of the rig and layout of the winches. A case of merchandise with the full weight on the fall boom is in the hatch. A line is seen to the right hanging slack; this

is the burton whip. The burton boom, or the outboard boom, extends to the right beyond the picture.

The winches are operated by steam and the steam pipes coming from the boiler room extend across the deck in the open air to the winches. Great care must be taken in the installation of steam-pipe

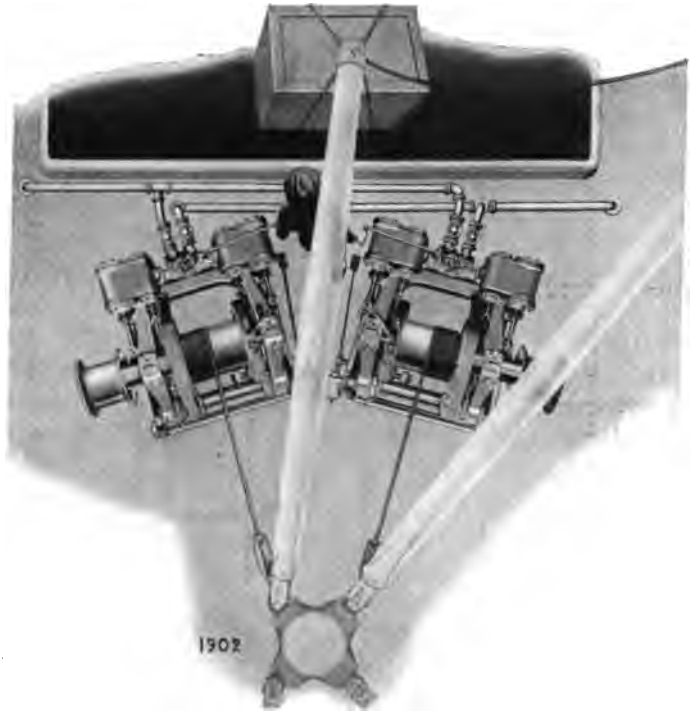


FIG. 35.—MASTHEAD VIEW OF RIGHT AND LEFT HAND WINCHES, WINCH RUNNER, BOOM, DRAFT AND HATCH OPENING. (*Courtesy Lidgerwood.*)

connections to deck winches, as the working of the ship will loosen the pipe and cause loss of steam and inefficiency. Unfortunately this is a condition that is rather frequent.

Hughes classifies winches as spur-geared, friction-geared, and electric winches.[2]

Two steam winches are shown in the illustration, a left-hand winch and a right-hand winch, with the operator in the middle, his right and left hands controlling, respectively, the right-hand and left-

[2] Chas. H. Hughes, *Handbook of Ship Calculations, Construction, and Operation.* D. Appleton & Co., New York, 1916, 626–628.

hand winches. The winches, if reversed in their position, would still be right-hand and left-hand. But in that case it would take two men to run them. The winches are constructed in this particular fashion in order to enable one man to run one with his right hand and one with his left hand and to bring the two machines closer together to economize space and to give facility for one-man operation. Stevedores sometimes call them the far-side winch and the near-side winch, determined by the position of the winch in relation to the draft.

There are several features besides control that make the winches of left-hand and right-hand pattern. The drum ends are on the opposite side of the winch from the lever handle, the rope or cable winds from the end of the drum away from the operator, that is, in all hoisting machinery, as a rule, the cables wind away from the gears. It will be noted that the gears are on the right-hand side in the right-hand winch, and on the left-hand side in the left-hand winch. This is to afford more direct application of power to the drum end. The brake is on the left end of the drum on the right-hand winch, and the opposite on the left-hand winch. Of course, the brake must be on the same side as the throttle. The intake steam pipe and the exhaust steam pipe are also reversed in the two winches.

The Winch Drum.—The winch drum should not be less than 16 inches in diameter, otherwise the bending strains will be very destructive to the rope. The ideal winch should have a range in speed from 50 to 450 feet per minute and a range in load from 100 to 10,000 pounds. The capacity of the drum should be not less than 500 feet of three-quarter inch rope.

The Drum End.—The drum end should also be of ample diameter. Stevedores hoist cargo with manila rope looped around the drum end. This is rapid and flexible, but expensive, as there is considerable slip and friction on the drum which wears or burns manila rope very rapidly. One seldoms sees a ship in New York ready to discharge its cargo without finding most of the rope brand new. The short ends of old rope are cut into convenient lengths for rigging, for making slings, and for other such purposes.

Special Types of Winches.—In general, many of the smaller types of vessels are designed to carry special cargo; consequently a one-design winch does not work efficiently in all cases; even on the

larger ships it is better to have more than one design of winch. In loading hay, for instance, a friction winch will work faster than a steam spur-geared or electric winch, while, on the other hand, for loading barrels, safes, and other heavy drafts a spur gear is practically a guaranty that the draft will not go through the bottom of the ship.

There is not always a separate winch for each fall. Most vessels have two winches and many have more at each hatch. There are three types of winches, according to Barnes.[3] The first type has only a central drum; another has only an end drum, and the third has a central as well as end drums. The third type is most common. The burton is wound around and attached to the central drum, the up-and-down falls are wound on the drum ends but are not attached. It is the duty of the drum-end man to cause a shortening or a lengthening of the fall as necessary. By using the three drums, one winch can handle three whips.

The selection of the different designs of winches to meet different uses may be illustrated by an example. A buyer came to a certain winch salesman and made known to him that he wanted a winch. The salesman described in great detail the merits of the spur-geared steam-controlled winch, that is, the winch that started, raised, lowered, and came to rest from the control of the steam throttle working through gears. But the buyer said: "Yes, that is all very well, but I need a single-friction winch, a winch driven by steam but with the transmission controlled by a friction clutch instead of by the regulation of the flow of steam to the cylinders, that is, by a throttle." The salesman, still thinking of steam, again extolled the merits of his steam winches. Finally the buyer said: "I do not believe you understand what I want to use this winch for. I am a fish dealer and I load large drafts of fish into my boat. The steam winch is too slow because it will not drop my load quickly enough. With the single friction winch, as soon as the draft is over the hatch the friction can be released and the load dropped into the hold. The fish will not go through the bottom of the boat, no damage is done to the boat, and much time is saved." Such a winch for loading general merchandise, particularly bars of iron and other heavy articles will be dangerous because the load, if inadvertently released, would go through the bottom of the boat.

[3] Barnes, *The Longshoremen*, 36, 37.

For heavy duty a two-speed ship winch is desirable. It is designed for use where heavy loads are to be handled on a derrick boom in addition to lighter loads on a general cargo boom, that is, it is constructed to lift twice the weight at half the speed. The slow speed, high duty, compound gearing, is used for the heavy load, obviating the necessity for parts of tackle otherwise required. A single gearing handles the light load at twice the speed. The throttle valve and reverse may be interconnected and controlled by a single lever if desired, but ordinarily separate levers for throttle and reverse are furnished. When it is desired to work with the single gear the clutch on the crank shaft is thrown into gear, and the crank-shaft pinion will directly drive the drum gear, and the load may be hoisted and lowered by steam; or the clutch can be thrown out of gear and the load held or lowered by the foot-operated brake which is fitted to the drum flange. To handle heavy weights at slower speed the clutch is thrown into gear with the pinion operating the compound gearing and the load hoisted, held, and lowered by steam. When working with single gear the clutch on the intermediate shaft may be moved out of connection and this shaft left at rest.

Electric Ship's Winches.—One manufacturer[4] presents the case of electric winches as follows:

On a number of ships it is desirable to use electric winches for cargo handling. This is particularly the case on motor ships and on other vessels where dynamos of large capacity are installed. Electric winches present new problems not encountered in steam-winch practice. The motors, controllers, and resistances must be made absolutely water-tight to insure proper working. Should water enter the casings of these parts the damage would be considerable, and would probably necessitate shop repairs. In some cases only the motor is mounted on the bedplate of the winch, the controller and resistances being placed under the deck in a dust-proof casing.

Fuse or circuit breakers are not furnished with the hoists, but are a part of the wiring circuit. One or the other is absolutely essential. They should be adjusted for not more than 50 per cent overload.

Either direct or alternating current can be used. Winches can be equipped with either type of motor.

It is found desirable in certain cases to use a continuous running motor, and to use the friction drum entirely for controlling the load. This requires a special type of friction drum. The continu-

[4] Lidgerwood Manufacturing Company.

ous running motor has been found particularly desirable where winch heads only are employed. Stevedores handle cargo by running the winch heads continuously and by tightening or slackening the rope on the winch head as required to hoist or lower the load. With direct-current motors this requires that the motor have the proper winding to prevent its overspeeding when running without load.

Solenoid brakes are furnished when ordered. They are generally desirable on electric hoists, as they provide an automatic safety device for holding the load when the current is shut off by the operator or by accident.

Dock Winches.—Proper handling equipment on the piers and wharves is as important as on the vessels. Wharf equipment is used not only to assist in loading and unloading cargo from vessels, but also to handle cargo on the wharves, where it is frequently piled for

FIG. 36.—ELECTRIC DOCK WINCH—STATIONARY. (*Courtesy Lidgerwood.*)

storage or has to be loaded and unloaded from cars, trucks, lighters, etc. Electric winches (as shown in Fig. 36) are preferable to steam winches for wharf use. The mobility of the winch is one of its most important features, and electric winches may be moved from point to point, modern piers being constructed with electric wiring and plugs at frequent intervals. Connections at these plugs with flexible cables make it possible to move the winch to any point on the wharf.

Winches on the pier would seem at first thought to be an unnec-

essary expense, since in most cases they simply replace a ship winch, but they have proved advantageous for the following reasons:

1. They can be used for handling lighter cargoes or in moving freight on the pier. Therefore they accelerate the loading or discharge of a vessel.
2. Since they are in almost constant use they are more liable to be kept in efficient working condition than the ship's winches.
3. If run by electric power, as many are, they have several advantages over steam winches—they have greater speed; their average operating cost is lower; they are safer, because of the greater power and uniformity of speed; they operate at short notice and eliminate stand-by charges when delays occur; they are not subject to frozen pipes or cylinders; and by use of the double portable master-controller they can be operated from any convenient point on the pier or vessel.
4. Frequently the ship cannot handle the cargo rapidly either because of lack of workable winches or a poor feed of steam. In such cases the pier winches prove of great value.[5]

Another electric dock winch is shown in Figure 36a mounted on wheels with wheel chocks. This apparatus has several distinctive features. It is a combination of two complete single-drum winches mounted on the same bedplate, with the drum and motor shafts in alignment. The motor shafts are arranged for interconnection so that the combined power of the two motors may be applied to either of the drums, the other drum being idle. With the motor shafts disconnected, each motor with the corresponding drum and winch head operates independently. This arrangement gives an opportunity to double the lifting power of any single drum and drum end. The operation of the whip is the same for any drum and drum-end winch. The solenoid brake, which is lifted by magnetism when the current is turned on and set with a powerful spring when there is no current, is plainly visible in the illustration. The solenoid brake is a characteristic safety feature of all electrical hoisting machinery and elevators.

[5] J. A. Jackson and R. H. Rogers, "The Status of Cargo Handling in American Marine Terminals." *International Marine Engineering*, Vol. XXI (1916), 356, 357. Also *International Marine Engineering*, Vol. XXIII (1918), 343, 344.

The control of this winch is a particular feature. The large box to the left of the machine is an automatic controller. The operator carries a rheostat suspended from his neck, similar to the car-switch control in an electric elevator, and this switch is connected with the controller on the winch by a live cable. This arrangement makes it possible for the winch runner or operator to move about and to observe the position of the draft. He is enabled thereby to overlook

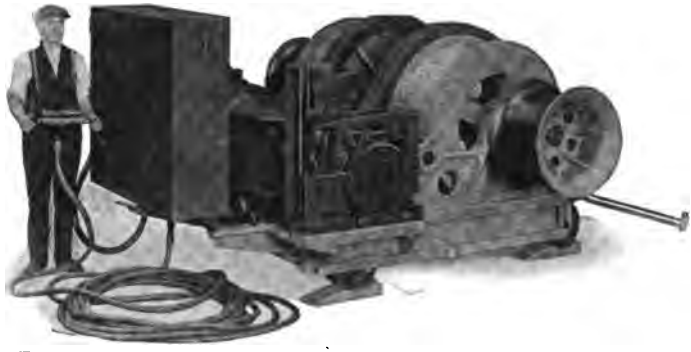


FIG. 36a.—ELECTRIC DOCK WINCH WITH PORTABLE CONTROL SWITCH. (*Courtesy Lidgerwood.*)

the operation throughout, dispensing with a signal man in most cases.

Many modern ships are abandoning the steam winch for the electric winch. This is particularly true in motor ships where no steam is maintained in boilers, except for heating purposes. The introduction of electric winches with a portable controller will do away with the hand signal man and in many cases with one winch runner. With a right-hand and left-hand control of two distinct drums, one operator can walk from the side of the ship to the hatchway, control both the burton and the fall at will, and perform the entire operation of unloading. This would reduce the winch personnel to the same as that of a crane operator and in addition would eliminate the signal man. With the development of motor ships this type of electric winch on deck, as well as on the piers, is bound to come into universal practice.

A single-drum electric winch mounted on wheels is shown in Figure 37. The truck is furnished with holding dogs that are driven into the wooden deck of the pier. This type of winch is particularly adapted for handling freight on the pier in small drafts because of its mobility.

Where electricity is not available, or where it is not practicable to keep up steam, as on a motor ship, or where it would not pay to keep up steam for any length of time, there has been devised a gas-engine winch. This type is adaptable to sailing vessels with auxiliary power and is also a valuable machine for lighters. The winch is quite similar in its operation and function to the contractor's gasoline winch that is used in building construction.

FIG. 37.—PORTABLE ELECTRIC DOCK WINCH—LIGHT DUTY.
(*Courtesy Lidgerwood.*)

Care of Electric Winches.—The care of electric winches is similar to the care of any other electrical hoisting apparatus. This will be described under Warehousing in the section devoted to elevators and lifts. The care required is the same as that for any other winch, steam or electric, the principle being that all running parts must be kept carefully oiled, free from grit and dirt, must be kept in alignment and protected from exposure. It may be summarized as follows:

1. All running parts must be carefully greased and oiled.
2. After loading dusty or gritty cargo the spur gears should be scraped.
3. When not in operation the winches should be kept covered with a tarpaulin or other waterproof cover.
4. The steam pipe should be carefully watched and the joints frequently repacked to prevent loss of steam and inefficiency.

In general, no machine should be called upon to perform its maximum capacity through long periods of time. A machine will break down through overwork as will the human body.

The lack of adequate transfer equipment is in many cases the reason that there is not simultaneous loading of all hatches. D. J. Murphy, Jr., a stevedore in Philadelphia, has said that of all the ships operating under the American flag to-day, so far as he knows them, there is only one (the *Felix Taussig*) whose winch system is sufficiently well planned and built to permit all hatches to be worked efficiently at one time. As an example of the poorly constructed vessel he quotes the case of the *Keketticut*, which arrived in Philadelphia from San Francisco with 9,000 tons of flour. Although there were 170 pounds of steam in the boiler, many of the winches could not be worked, and, as a result, only two gangs could be used on the five hatches. He estimates the time lost in discharge as at least three days. He further states that the *Edgemont*, the *Edgemore*, and the *Edgewood*, all new vessels belonging to the United States Shipping Board, have such a faulty steam-feed system that No. 1 hatch cannot be worked at the same time as No. 3. He lays the blame largely on the ship architect [6] for installing boilers or feed pipes that are too small to give the winches the proper amount of steam. Others [7] lay the blame, not on the equipment itself, but on the handling of that equipment, pointing out that the donkey engines are not kept in proper running order and that steam is wasted by the winchmen. Undoubtedly there is truth in both views; the laborers are careless and the architect has not taken this carelessness into consideration when designing the vessel. But after the vessel has been put in service, the best remedy is to keep the equipment at maximum efficiency, and the American masters are particularly lax in this regard. A comparison is often drawn between the efficiency of

[6] That the fault may be with the owner rather than with the architect is indicated by the following quotation from the *Pacific Marine Review*, Vol. XVI (1916), 127:

"A feeling has prevailed among shipowners in the past that a winch being placed on deck, exposed to the weather, need not have the same refinement in design and construction that would be required of an engine-room equipment. This is true so far as the exterior finish of the winch is concerned, but the mechanical efficiency of a winch on deck is just as important as that of a ship's engines. This fact has been lost sight of by many owners and officers. They have called for rugged, rough winches to stand exposure, forgetting that these qualities can be combined with mechanical excellence. The result has been carelessly designed steam passages, resulting in back pressure; bearings that are seldom in proper alignment, carelessly constructed and filled with cheapest bearing metal, gears that do not mesh properly, and cylinders bored out rough. One need only listen to the racket made by an ordinary ship's winch to appreciate the loss of power. This is accepted by many ship's officers as being natural and proper in a winch—it is their accepted standard of a winch. However, these conditions have changed."

[7] Notably Mr. Loveland, another Philadelphia stevedore, who disagrees altogether with Mr. Murphy.

the equipment on Scandinavian and American vessels, much to the disadvantage of the American. It is easy to allow equipment not used on the voyage to fall into disrepair, and it is difficult for the new master, especially, to realize the excessive cost of such neglect. It not only prevents the working of all hatches, but it delays transfer at each hatch. He must continually remember that time lost in port is a large item in operating expense, even though it does not appear on the cost sheet.[8]

Starting the Draft.—A heavy load must be started gradually. Care must be exercised to prevent it from colliding with the hatch coamings and other objects in the hold or on the pier. Also, great care and judgment must be shown in hooking on a heavy draft; much more than in the handling of light drafts. There is a great rope stress developed in starting drafts quickly. A five-ton draft started too quickly may produce a rope stress of seven or eight tons. Repeated too often, the rope may break when the load is in the air. The winch runner must be carefully instructed as to starting and stopping in order not to cause undue strain upon cables, blocks, machinery, and other rigging. Also, if the draft catches under a corner of the hatch or the pier shed, or in any other way becomes fouled, quick action must be taken to stop the winches.

Signaling

Signaling in loading or unloading is very important. Signaling is the same whether the transfer is being done with ship's tackle or with shore cranes. Each time a draft is transferred or a hook is returned to its original position to receive another draft, a series of movements is necessary on the part of the winch runner or the crane operator. It is impossible for a winch runner to be in a position to see both ends of the movement. The same applies to a crane operator. The man running the winch can see into the hatchway and can control the movement of the hook so long as it is in the hatch square. He is not in a position to watch the movement of the hook and the draft overside on the lighter or the wharf deck or back in the hold. It is important when loading a vessel to stop the draft before it goes to the floor or "ceiling" of the ship, and then lower it gently to the point of deposit; and when dragging a draft out from

[8] Thomas R. Taylor, *Stowage of Ship Cargoes.*

behind the hatch opening in the hold additional provision must be made for relaying signals. It is essential that the winch runner be stopped on an instant's notice if the draft catches or fouls anywhere, otherwise the gears, rigging, draft, or the ship itself may be injured. Also, for the safety of the entire stevedore gang, a uniform and well-understood system of signals is absolutely essential.

The signal man is usually the captain of the stevedore gang. He is the boss stevedore for some twenty or more men working in a gang. Usually one gang works with each fall or hook, therefore for every hook in operation in the hatch in transfer movement there must be a signal man, as one man can watch only one hook throughout its cycle. He paces back and forth with each draft from the ship's rail to the hatch coaming, or from the hatch coaming to the ship's rail.

Uniform signals do not exist. Each signal man seems to have his own signals with which his particular winch runner is familiar. In spite of the diversified methods in signaling the differences from one hatch captain to another are rather in the nature of mannerisms than in a fundamental difference in the signal. As in all such trades or vocations, the signals develop naturally just as many words in our language have been developed by imitation of sound or motion.

In order to develop uniformity and to show the fundamental principles in practice in signaling, a description of the various movements, with photographs,[9] of a gang captain of particular efficiency and intelligence are shown herewith. This particular gang captain was a captain in the United States Army in charge of a stevedore company in France. He stated that he earns more as a longshoreman gang captain than he did as an army captain. His hourly rate is 5 cents higher than that of the deck men, that is, at the last rating he would be receiving 85 cents an hour for an 8-hour day, and $1.27½ for overtime.

Stop.—The signal to stop is always the arm centered with the palm down. See Figure 38.

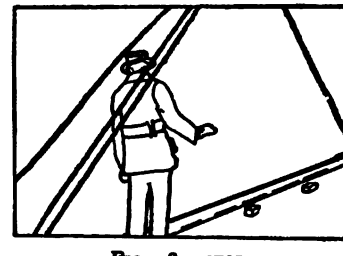


FIG. 38.—STOP.

[9] The photographs taken by the author of actual operations are reprinted here only as sketches.

Lower Slowly.—The draft is being lowered on to a lighter. The signal "stop" has held the draft a few feet above the deck of the lighter; from this position it is lowered slowly to the deck by the signal man moving his hand or the fingers of his hand downward in a short, quick motion, until the draft has reached the deck. See Figure 39.

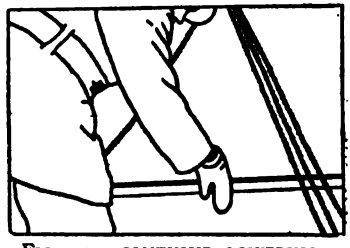


FIG. 39.—CONTINUE LOWERING.

Continue Lowering.—Continue lowering is indicated by holding the position of Figure 39.

Lower Away.—To lower away continuously until halted, the forearm or the entire arm is pulled downward until it hangs by the side. This motion is made decisive. It is intended that the draft should be lowered considerably and at a rapid speed.

Up Slowly.—The hand is extended with the palm up and the fingers closed or the hands raised repeatedly from the wrist with a sharp movement. See Figure 40. In pulling up on the hook until it engages the rope, and until the sling is taut in order to have the bite driven down on the rove, the motion of hauling up, or holding ready to lift, is indicated by the palm extended in rest, or moving the fingers up. See Figure 41. The curve of the wrist in Figure 40 shows the changed position for the short movement.

FIG. 40.—UP SLOWLY (SHORT MOVEMENTS OF THE WRIST).

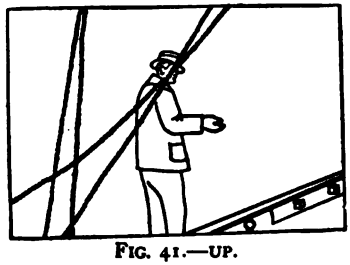


FIG. 41.—UP.

The signal man in Figure 42 is indicating to "hoist slowly" by moving his first two fingers and thumb, or bringing them together in a series of pinches. He is looking into the hold at this particular point.

Sometimes the signal men hold a short stick or a broken piece of pineboard that is easy to see, and

move this stick in small oscillations in the same manner as indicated in the other signals.

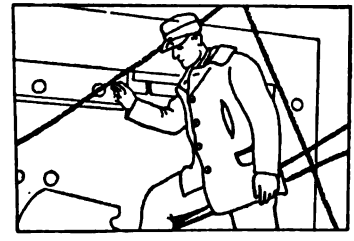


FIG. 42.—UP SLOWLY. Signaled by bringing fingers and thumb together in pinches.

It behooves every one working around a ship transferring cargo to keep an eye on the signal man, and any person responsible at all for the loading and discharging of the vessel should take great care that the winch runner and the signal man are in complete accord as to the signals. There is considerable danger connected with the longshoremen's trade in loading and discharging ships, and attention to these matters will save much loss of property, and more than that, loss of life.

CHAPTER VIII

CARGO TRANSFER: III. DRAFTS[1]

In practically all cases of transfer of cargo between ship and shore, except in those few cases where continuous motion machinery, such as belt convevors, banana unloaders, etc., is used, cargo is transferred by drafts. A "draft" is a single lift of merchandise, often a collection of small packages, such as barrels, bags, crates, bound together in a sling and hooked on to the end of the cable that is being operated by the winch or crane. The arrangement of the draft so as not to break the merchandise or cause other damage requires considerable attention to details. Drafts are similar in composition regardless of whether the transfer equipment be cranes or ship's tackle. Drafts are usually about 1,000 to 2,000 pounds in weight. It has been found that faster work is possible if less is taken at a time. The modern cargo booms will lift 5 tons.

FIG. 43.

The hook requires no particular explanation. It is well curved so that it is not easy to slip the sling out of the hook by accident. It is spliced securely to the end of the wire or manila rope cable (Fig. 43).

SLINGS

The draft is lifted by "hooking on" to a sling that may be of various types. The simple *rope sling* (Fig. 44) is most generally used for boxes, bales, crates, bags, etc. It is a length of hemp rope between 12 and 24 feet long, with the ends spliced together to make it endless. These slings are made by the longshoremen from ends

[1] By R. S. MacElwee and T. R. Taylor. Some field work and the analysis of movements with tables and sketches, by L. H. H. Haight and M. M. Grass for the United States Shipping Board, Emergency Fleet Corporation.

of manila rope whips which have become worn in spots doing duty as burton or fall. Although the rope when spliced is "endless," the sling itself, when laid out on the floor to receive its load, has two

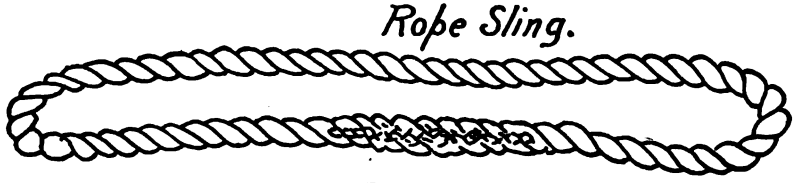


FIG. 44.

ends and two sides. To load the sling a plank is laid on the pier deck and the sides of the sling are made parallel with the plank. The boxes or bags are piled on the plank and the two ends of the sling brought together above and around the merchandise. As soon as a sling is put around the draft each end is used for a different purpose and is given a different name. Care is taken to have one end of the sling considerably longer than the other. Before the draft is raised the long end of the sling is passed through the short end. The long end is called the "long rove," or simply "the rove," while the short end through which the rove is passed is called the "bite" (Fig. 45). The rove or long end is put on the burton hook and when the draft is raised so that the sling is taut the longshoreman drives the bite down tight on the rove with a short length of pipe or piece of wood.

FIG. 45.

FIG. 46.—A WEB SLING FOR SOFT BAGS.

A web sling is the usual rope sling with the central portion, perhaps one-half or two-thirds of the length, "webbed" or fastened together by sacking or canvas duck webbing similar to a hammock. The ends are left free to act as bite and long rove. This type of

sling is used primarily in lifting bags of sugar and such merchandise in bags that might be cut open or burst by the pressure of the rope of the sling alone (Fig. 46).

Cant hooks are used to transfer barrels (Fig. 47). For handling barrels, unless the same are handled by the ordinary rope sling, very often the single large hook at the end of the burton fall is replaced by four hooks in pairs; each pair to lift the end of two barrels, that is, one hook at each end of each barrel. This form of hitch for the draft is sometimes used on cases, or boxes, but is a dangerous method of transfer (Fig. 48).

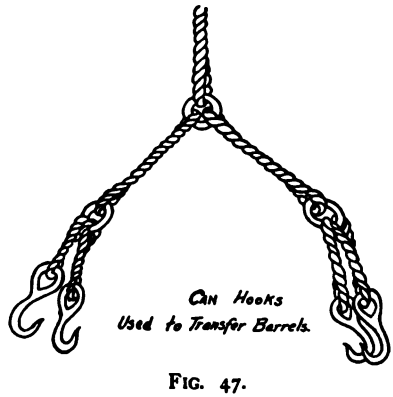


FIG. 47.

The net sling is used in transferring small packages of miscellaneous size and shapes that are of sufficient strength in packing to resist the pressure of their neighbors in the net when the four corners are drawn together. Passengers' trunks are usually transferred in slings. The net sling is usually constructed during slack hours by longshoremen familiar and skillful in splicing. When the corners are brought together the long loop (rove) is passed through the short loops and a hook passed through the rove. Slings are also used between the ship and the shore under a draft to catch any packages in case a draft should slip and drop some of its load.

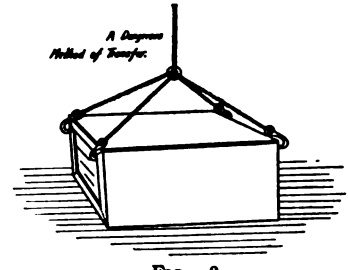


FIG. 48.

The *platform sling* or *airplane* is a heavy timber skid with ropes spliced to the four corners and ending in an iron ring or rope loop through which the hook of the fall may be passed (Fig. 49).

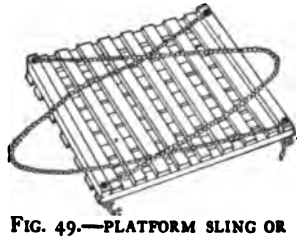


FIG. 49.—PLATFORM SLING OR AIRPLANE.

In order to arrive at a knowledge of a more or less uniform method of handling drafts at the various piers along the Atlantic seaboard, L. H. Haight, and M. M. Grass, of the Emergency Fleet

Corporation, made a close study of the transfer of cargo on seventeen different piers. As a result of their investigation, made especially in the preparation of this work, the following analysis of movements and diagrams are submitted. The sketches and tables of movement were prepared by these gentlemen especially for this volume.

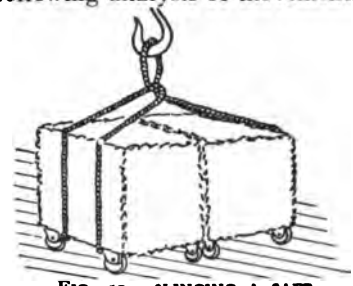


FIG. 50.—SLINGING A SAFE.

TRANSFER OF FREIGHT

Loading a Safe.—As an example of a heavy draft in a single package, the introductory analysis will be that of the transfer of a safe (Fig. 50). As these movements are characteristic of many other drafts and transfers, the subsequent drafts will refer back to the case of the safe. It is, therefore, desirable to understand the various movements in the loading of this safe preliminary to the study of other drafts. (See next page.)

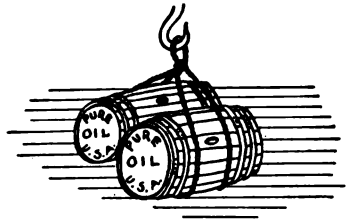


FIG. 51.—BARRELS SLUNG "MARRIED."

Loading Barrels and Hogsheads.—Various methods of slinging barrels and hogsheads are shown in the accompanying diagrams. Barrels are easy to handle on the pier or in the hold because they roll, but they are difficult to sling properly. The method used depends largely on the form, weight, and strength of the barrel. Perhaps the most common practice is to sling two at a time ("married") by use of cant hooks, but this cannot be done if the chimes of the barrel will not support its weight. The American Sugar Refining Company recommends that barrels of sugar be transferred by nets, but their recommendation is not adopted by most stevedores.

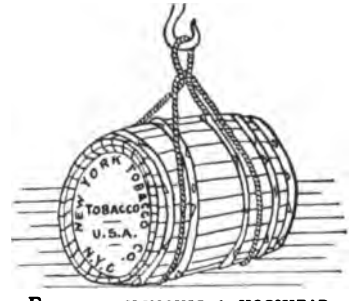


FIG. 52.—SLINGING A HOGSHEAD.

Loading Bags of Sugar, Grain, Coffee, etc.—The sling (a web sling, Figs. 46 and 53) is laid flat on the deck of the pier and

the bags are placed across it. The ends of the sling are then brought together, and the rove is placed through the bite and attached to the hook of the fall.

LOADING A SAFE

Classes of Work Done

Men Required	Individual Duties	Jobs Done
One superintendent	Superintends entire work of loading and unloading ships	Loads the ship on paper, sees that the ship is loaded evenly on both wings and with a drag after
One stevedore	Supervises the stowing through hatch; supervises the discharging from hold	Forms the shape (gets the men in line); calls the gangs; places the gangs; keeps the gangs filled; sees that the ship is loaded as the superintendent has planned on paper
Two deck foremen	Supervises loading his end of ship; supervises discharging his end of ship	Gets required number of gangs for the hatch; places the gangs on the job; looks after each detail of loading and unloading; keeps gangs filled
One checker	Counts all men and drafts	
Two slingers	Work on pier helping prepare drafts for loading and unloading	Handles slings, trucks, etc.; rolls or places drafts to nearest loading point
One gangway man	Supervises signaling	Signals to raise draft from pier or hold; signals to stop draft on pier or in hold; signals to raise fall from pier or hold
One winch runner	Starts winch; stops winch	
Drum-end man (burton fall)	Handles fall on drums	Puts two turns of fall on drum; waits for signal; at signal, puts enough turns on drum to lift draft; at signal, tightens fall enough to lift draft; keeps fall tight by coiling; to lower draft loosens fall on drum
Drum-end man (up-and-down fall)	Handles fall on drum	Waits for signal; at signal, puts two or three turns of fall on drum to take up slack; puts two or three more turns of fall on drum to lift draft; puts two or three more turns of fall to take full draft; lowers draft through hatch.

The number of bags to the draft varies with the commodity and with other factors. Six or seven bags of raw sugar will make a draft of about 2,000 pounds and this is a convenient weight on the customs scales. In handling refined sugar the common draft is twelve bags.

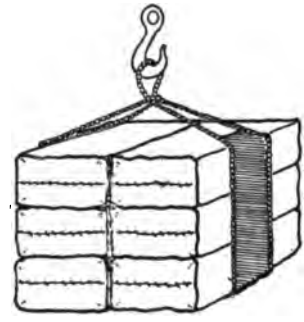


FIG. 53.—A WEB SLING DRAFT OF BAGS.

Loading Beef.—Perhaps the loading of beef requires the least skill in handling of any freight making up the cargo for a ship. It is generally loaded directly from the truck to the ship in order to get it into the refrigerators as soon as possible. It is handled in a "net sling" which is about 6 by 8 feet, with 8-inch mesh. The sling has a rope around the edge, with a loop in the center of each side and each end. The loops on one side and one end are longer than the loops in the opposite side and end. The long loops are called "roves," and the short loops are called "bites."

When the truck is backed to the nearest loading point and the net sling laid flat on the floor of the pier, about ten quarters of beef are tossed into the net sling; the edges are folded over; the roves are passed through the bites and on to the burton hook; and, when the signal is given to hoist away, the sling is drawn taut and the beef is held securely until lowered into the hold.

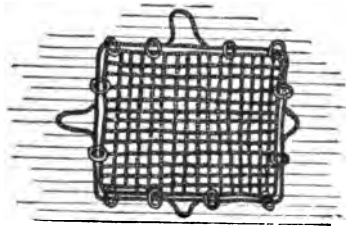


FIG. 54.—A NET SLING FOR BEEF.

At New York in handling frozen or chilled meat arriving in refrigerator cars, the cars are floated alongside the ship and the cargo loaded overside from offshore. This is slow and expensive for ordinary cargo but of obvious advantage in the movement of all refrigerator groups from car to ship with little loss of temperature.

Discharging frozen mutton and other meat at London has become almost entirely a mechanical, continuous motion; belt conveyors with steel baskets operating similar to a banana unloader are lowered into the hold. Once out of the hold, the halves or quarters are

hooked on to a meat hook on wheels that travel by gravity or chain propulsion along the wharf to waiting cars (goods wagons) or drays.

Loading Eggs.—Eggs are packed in rather flimsy crates and therefore must be handled carefully. In order to eliminate handlings the crates should be stored on the transit shed as near as possible to the picking-up place, or should be moved direct from the car or truck to the sling. If the truck can be backed up to the loading point, one man on the truck can pass the crates to a second on the pier floor, who places them crosswise on a platform, carrier, or "airplane" (Fig. 55). Twelve cases make a draft. In order to protect the cases from being crushed by the carrier ropes, angle irons are placed at the outside edges of the upper tier. These angle irons, or "bosses," have holes through which the ropes pass. The lifting pressure is thus distributed along the crates.

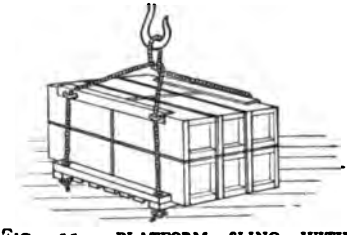


FIG. 55.—PLATFORM SLING WITH ANGLE IRONS TO PROTECT FRAGILE CASES.

In swinging the draft care must be exercised to avoid bumping it against the sides of the vessel, the hatch coamings, or the decks. This method is used for all flimsy containers of a regular shape, such as crated fruit.

Loading Dried Apples.—Dried or evaporated apples in cases are generally loaded on a special platform, or airplane. Since the boxes are light in weight, about twenty are put in each draft, making a total weight of between 1,500 and 2,000 pounds. The ordinary form of airplane is shown in the accompanying diagram (Fig. 55). To keep the carrier ropes from crushing the boxes, angle irons are sometimes used as described in the discussion of loading eggs.

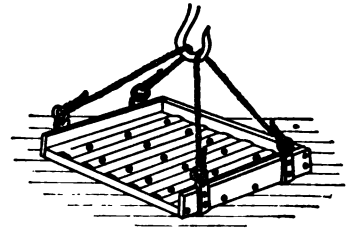


FIG. 56.—PLATFORM FOR LOADING IRON AND OTHER METALS IN PIGS.

Oranges, grapefruit, and similar commodities are handled in about the same way.

Loading Pigs and Billets.—Billets and pigs of metals were at one time generally transferred by use of chain slings, and some of

the smaller steamship companies still use this method, but modern practice is to use a special airplane (Fig. 56). This is a platform, 2 to 6 feet square, with a ribbed floor and with boards 4 to 6 inches high around three sides. Ropes attached as shown in the diagram balance the load when it is raised, although there is danger that some of the pigs will fall out of the open side if the airplane is tilted in that direction.

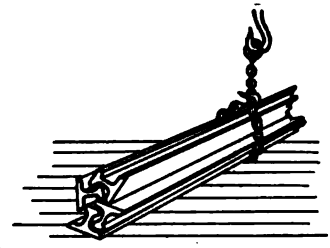


FIG. 57.—CHAIN SLING FOR STEEL RAILS.

Loading the airplane simply consists in throwing on the pigs until the proper weight is obtained. To unload, one rope or sling is detached from the hook, so that hoisting away on the other rope will dump the pigs or bars in the hold. This is a quick way of handling small pieces that are not damaged by rough treatment.

Loading Steel Rails.—An exceptionally high degree of skill is required to sling steel rails, pipe, iron lamp-posts, and similarly constructed objects, in order that the work may be done quickly and that the bars may be carried securely and at the proper angle.

A different type of sling is used in this case. It consists of one or two chains forged to a ring at one end and terminating in a hook at the other, quite similar to cant hooks just described but removable from the fall (Figs. 57 and 58). When handling rails, the hook of the chain is passed around the end of a bundle of four or five rails and hooked on to the chain with the point directed toward the long part of the draft. The ring is then placed on the hook of the fall, and the draft is raised far enough to allow a block of wood to be set under the end. The draft is lowered on this block and the chain is slid along the rails for a distance of about one-third their length. It is now in a position that allows the draft when elevated to hang securely and almost perpendicularly. The rails can thus be lowered into the hold and can swing toward the stowing point more easily than if they were in a horizontal posi-

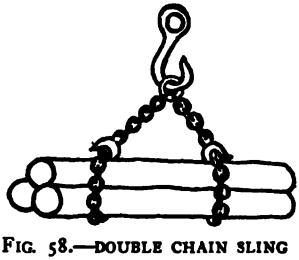


FIG. 58.—DOUBLE CHAIN SLING FOR LARGE IRON PIPES.

tion. Care must be taken that the chain sling is tight and that it exerts sufficient pressure on all the rails or pipes in the draft to prevent any one from slipping out and going through the bottom of the ship or the lighter. All such long, heavy articles are troublesome to load.

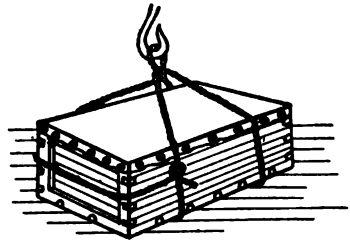


FIG. 59.—SLINGING AUTOMOBILES.

Loading Automobiles.—Automobiles for overseas shipments are usually partially demounted and packed in large, strong boxes, about 4 by 6 by 12 feet in dimensions. The large cases for the army trucks during the World War were about 3 by 4 by 23 feet. These boxes, after being landed on the pier, are rolled on iron pipes to the nearest picking-up point, and the sling is placed around them. The sling is placed just to one side of the center of the box. A line is made fast to the sling, passed around the long end of the box, and fastened to the sling on the opposite side. This permits the box to tip at an angle which makes it easy to lower through the hatch, and yet prevents it from slipping out of the sling. It is best to have the farside winch take the slack of the sling before tying on the line.

Loading Assembled Locomotives.—The accompanying diagram (Fig. 60) illustrates the method of loading locomotives, used in forwarding shipments to the American Expeditionary Forces. The locomotives were run upon car floats, which were towed to the side of the floating derrick stationed alongside the receiving vessel. Only a few vessels having exceptionally large hatches could be used to carry these assembled locomotives.

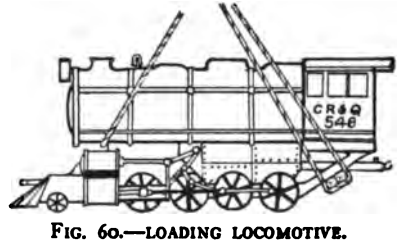


FIG. 60.—LOADING LOCOMOTIVE.

In the frontispiece the locomotive has been raised from the car float and swung over the crane barge. When the guy line is changed it will be raised, swung over the hatch of the vessel to the left, and lowered into the hold. The transfer of the locomotive, weighing 150,500 pounds, can be accomplished in twenty minutes. It is necessary to keep the locomotive "head up" in spite of the tendency to revolve with the crane. This is accomplished by means of guy ropes.

Most Important Types of Containers

The twelve or fourteen pieces of cargo listed and described above do not include all of the package freight a stevedore has to handle, but were selected because they cover every operation in loading and discharging. To list more would simply mean a useless repetition.

Of the various kinds of merchandise carried by ships to-day, we have been able to list 4,761 items, and this number is approximately correct. It is interesting to note that this great variety of material is carried in only forty different kinds of containers; many of these containers differ only slightly. While the number of packages will probably increase, the number of different containers will undoubtedly decrease because of improvements in packing.

Below is tabulated alphabetically the different kinds of containers, and the number of different kinds of articles usually packed in such a container.[2]

Bags	371	Casks	115	Pipes	2
Bales	445	Chests	8	Puncheons	2
Barrels	438	Coils	8	Reels	22
Bars	8	Crates	160	Rolls	48
Baskets	170	Cylinders	19	Sacks	60
Boxes	395	Demijohns	3	Scroom	3
Bulk	50	Drums	80	Slabs	4
Bunch	8	Firkins	2	Spools	4
Bundles	160	Hampers	6	Straps	4
Butts	4	Hogsheads	38	Tierces	38
Cakes	29	Kegs	166	Tubs	8
Cans	6	Packages	91	Trunks	2
Carboys	10	Pails	4		
Cases	1749	Pieces	31	Total	4,761

[2] *Stowage of Ship Cargoes*, by Thomas R. Taylor. Misc. Series No. 92, Bureau of Foreign and Domestic Commerce. Government Printing Office, 1920.

CHAPTER IX

TYPES OF CRANES AND DERRICKS[1]

Transfer by Crane

The question of transfer by crane deserves the most careful consideration. In the first place, most of the great foreign ports are equipped with cranes for transfer instead of the usual deck equip-

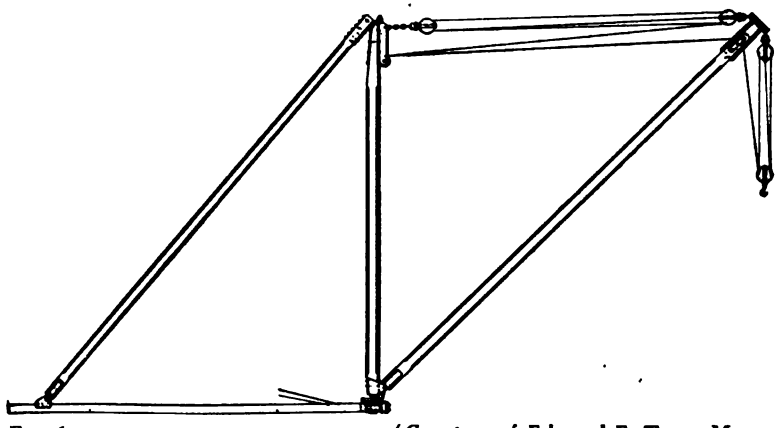


Fig. 61.—A timber stiff-leg derrick. (*Courtesy of Edward F. Terry Manufacturing Co., New York.*)

ment and rigging or cargo masts of the type that have been discussed in connection with American ports. In addition, there is the very animated controversy between the old school of American port engineers and the new school, particularly the members of the Society of Terminal Engineers, as to the relative merits of cargo masts, ship's tackle, and cranes for the transfer movement. By all means, persons connected with the steamship business, whether ashore or afloat, must be sufficiently familiar with the various types of cranes

[1] By R. S. MacElwee.

to recognize them on sight and know their outstanding features, their names, and the services that they are meant to perform.

In this discussion it must be borne in mind that the usual wharf crane, as developed abroad and here, has not a very much greater capacity than the cargo winch and mast for the usual transfer of package freight. The heavy draft, such as locomotives, automobiles, large pieces of machinery, castings, heavy ordnance, and other heavy

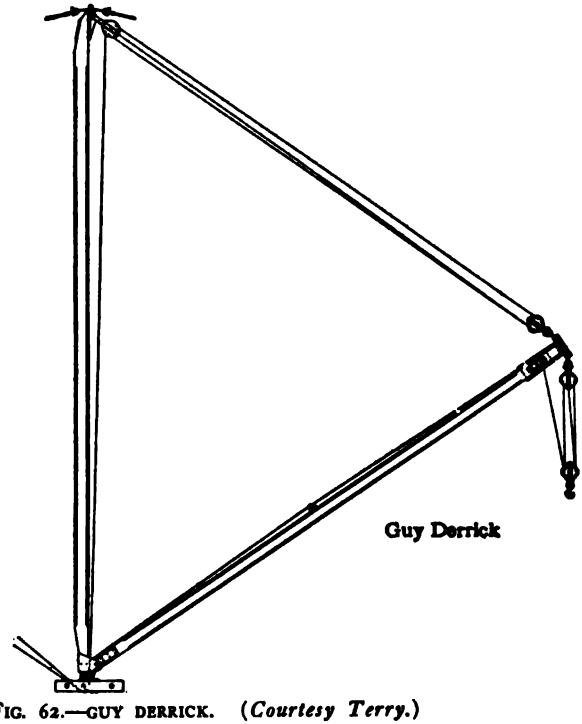


FIG. 62.—GUY DERRICK. (*Courtesy Terry.*)

objects are handled by specially constructed heavy-duty cranes. Wharf cranes are, therefore, divided into two large groups, light duty and heavy duty. The drafts are handled much the same by a crane as by any other transfer equipment. After the draft is made up the hook of the fall pendent from the crane is attached to the long rove and the draft is lifted and lowered just as it would be by a burton-and-fall rig.

Stiff-leg Derrick.—The simplest form of a hoisting machine of the crane or derrick type is the *stiff-leg derrick*, or *stiff-leg* (Fig.

61). This is the form usually found in building construction, but can be used to advantage at any temporary wharf or for handling bulk material in small quantities from scows. The boom from which the block and hook hang to lift the draft is stepped at the base of the vertical "stiff-leg." It is raised or lowered by cables from the masthead and can be slued about through from 200 to 260 degrees.

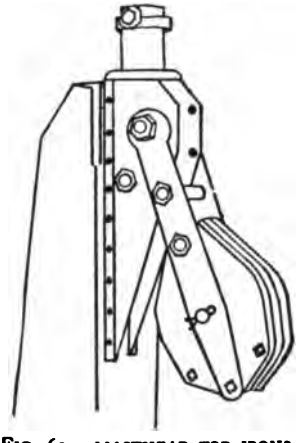


FIG. 63.—MASTHEAD TOP IRONS OF A GUY DERRICK.

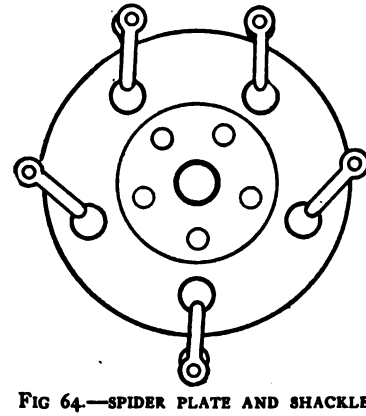


FIG 64.—SPIDER PLATE AND SHACKLES.

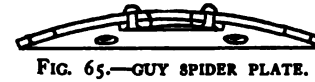


FIG. 65.—GUY SPIDER PLATE.

The vertical mast or leg is held in place by two bracing timbers from the masthead to the ground, or to the end of a sill, ground beam or base beam. The three timbers form a right-angle triangle. In fact, there are two timber triangles with one side—the vertical leg—common to both. The length of the boom is usually one and one-half times the length of the stiff-leg, or mast. With the horizontal leg securely anchored to the ground at each end it will be seen that this frame is capable of great stability against the tendency to tip over.

A-Frame Derrick.—A modification of the stiff-leg is the A-frame derrick. The "mast" in this case consists of a three-timber tower or pyramid with a hinged boom similar to that of a stiff-leg derrick, stepped in a socket set in a sill or horizontal timber connecting the feet of two of the timbers, thus forming a letter "A," crossed at the bottom. This form is used largely for heavy-duty or confined areas, such as barges, lighters, etc. These simple derricks may be operated by hand or rigged with steam, gas, or electric

winches. They are capable of construction from small to very large capacities.

Stiff-leg derricks may be built either of timber or steel.

The Sheer Leg Derrick is quite similar to the "A" frame.

Traveling Stiff-leg Derrick.—A stiff-leg or A-frame derrick may be placed on a platform and this platform mounted on wheels that run on tracks. In this form the stiff-leg derrick becomes a "traveling" derrick because it is possible for it to be moved along a track from one point to another.

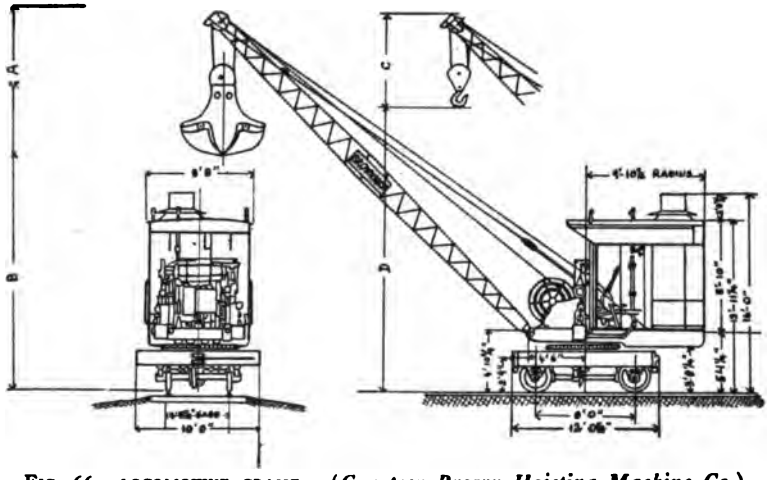


FIG. 66.—LOCOMOTIVE CRANE. (*Courtesy Brown Hoisting Machine Co.*)

The terminology of derricks and cranes is very simple, as it is built up descriptively as are the formulas in organic chemistry.

Guy Derrick.—The guy derrick is used much like an A-frame on the stiff-leg derrick. In the place of the A-frame, however, the vertical leg or mast is kept in an upright position and given resistance against the tendency to tip over in lifting a load by running guy ropes from a guy spider, with shackles, in four or five directions from the masthead to anchors at some distance from the mast.

Locomotive Crane.—The locomotive crane, as its name implies, is a steam crane mounted on trucks and capable of moving along a standard gauge railroad track like a locomotive. It is a very useful instrument, particularly in terminals where the traffic is not sufficiently heavy to warrant extensive installations of heavy-duty cranes. Where the locomotive crane is of high lifting capacity,

and therefore needed only occasionally at various points along an extended water front, its mobility is of great value, as it can be directed to that part of the water front where heavy transfer work may happen to be desired. Until traffic over a wharf becomes of sufficient volume to support the overhead of a complete gantry-crane equipment, one or two locomotive cranes will take care of the situation in conjunction with ship's winches and cargo masts for the lighter work.

As a rule, the boom of the locomotive crane is hinged and can be lowered and raised. When the locomotive crane is traveling the boom is usually lowered to a horizontal position along tracks. The boom may be slued as well as raised and lowered.

A revolving or full-circle locomotive crane is the usual type. The drums and winding apparatus are mounted on a small turntable that is capable of revolving through a full circle. This is much more positive and rapid than sluing.

Locomotive cranes are self-contained units, that is, being steam cranes they are independent of other sources of power. The terminals of the New York State Barge Canal are fitted with self-contained locomotive steam A-frame cranes mounted on wide-rimmed wheels.

Tower Crane.—A tower crane is a crane mounted on a tower. The crane itself may be constructed on the principle of a stiff-leg derrick, a guy derrick, or any other type, and with a fixed or a hinged boom. Electric power is generally used, as it is not an advantageous installation to have a steam crane on a tower.

This crane may be of the full-circle type, in which case the rig would be called a revolving tower crane.

Traveling Revolving Tower Crane.—A traveling revolving tower crane is simply a revolving tower crane placed on a tower that is capable of being moved along tracks, that is, a tower that can be made to travel.

In this nomenclature it will be noted that, like the nomenclature of organic chemistry, it is possible to string the names of the component parts together until the full name of an installation describes it completely. For instance, a crane may be described as a hinged-boom electrical revolving traveling tower crane. To this may be added the capacity or "heavy duty." The hinged-boom traveling and revolving electric tower cranes are the type used so largely in shipyards (see Fig. 67).

Hammerhead Crane.—The cantilever crane is usually a heavy-duty rig and is found in the fitting-out basins of shipbuilding plants. It is usually a fixed-tower revolving crane, but smaller types may be mounted on traveling towers (Fig. 68). "Cantilever" refers to the characteristic of the arm of the crane that extends out over the object to be lifted. In this case, instead of being a boom at an angle and supported by cables from the top of the boom, the arm extends horizontally and is of cantilever construction, that is, it is

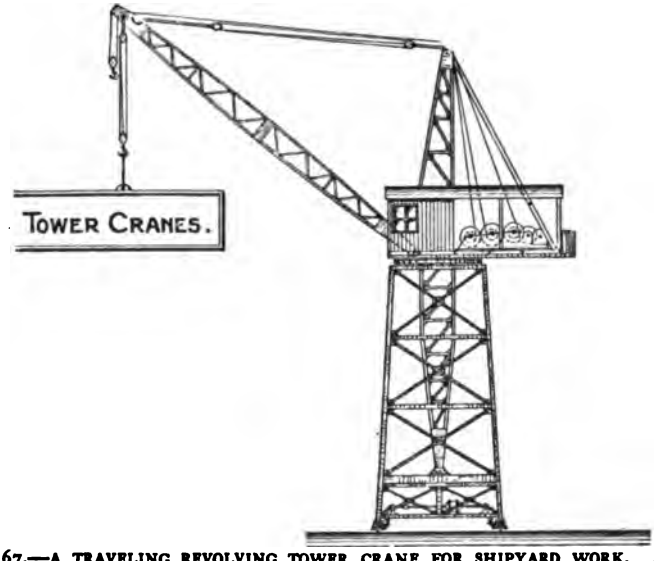


FIG. 67.—A TRAVELING REVOLVING TOWER CRANE FOR SHIPYARD WORK. At the port of London many are used for wharf work. (*Courtesy of Terry.*)

supported by one end only. The weight or load being carried by the crane, including its own weight, is transferred to the chassis of the main supporting column or tower.

If not counterbalanced, such a tower, with a cantilever arm projecting from the top, would tip over. The counter weight is made up partly by the electrical winding machinery. The counter weights and machinery being placed at the opposite side of the tower from the lifting arm give the crane the appearance of a hammer, from which the name "hammerhead" crane is derived.

In cantilever cranes, particularly for heavy duty, the horizontal movement of the load is performed by a running gear or traveling carriage that is suspended from rails underneath the cantilever arm

and is drawn back and forth along the track by cables or operated by its own motors. Some of the very large cranes have several of these carriages traveling horizontally along the cantilever arm and also may have small cranes traveling along the top of this boom. The

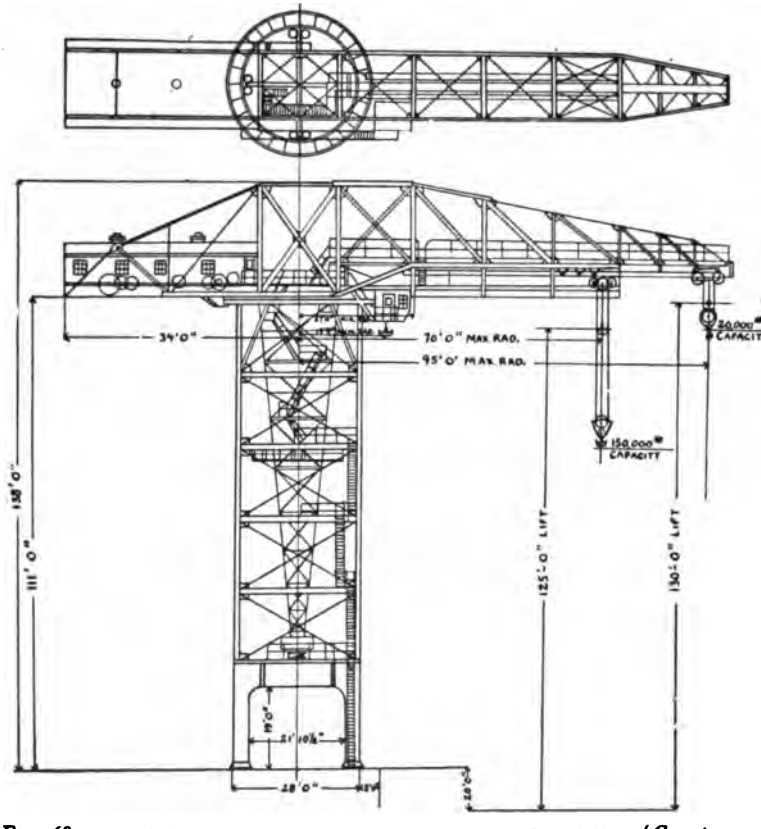


FIG. 68.—HEAVY DUTY REVOLVING HAMMERHEAD TOWER CRANE. (*Courtesy of Wellman-Seaver-Morgan Co.*)

complete name for one of these heavy-duty cranes would be "revolving hammerhead tower crane." However, in order not to confuse the cantilever hammerhead with the movable-boom crane, one is called simply a hammerhead crane, and the other a tower crane.

The Gantry.—In the discussion of water-front equipment the word "gantry" is used probably more than any other single name of a crane. A gantry crane is a crane mounted on a gantry. "To

gant" means to overhang or to span. A gantry, therefore, is any framework that spans. For instance, in railroading, the signal blocks above the tracks are mounted on a gantry—a framework that spans the tracks.

In a wharf gantry crane, the framework spans the wharf apron or the outer part of the wharf toward the water, and usually this spanning is in order to leave the space clear the full length of the wharf apron for the railroad sidings that are laid upon it. A wharf gantry crane has to span from one to three tracks and sometimes, in addition, a landing platform of 5 to 10 feet in width.

Gantry cranes, and particularly wharf gantry cranes, in which

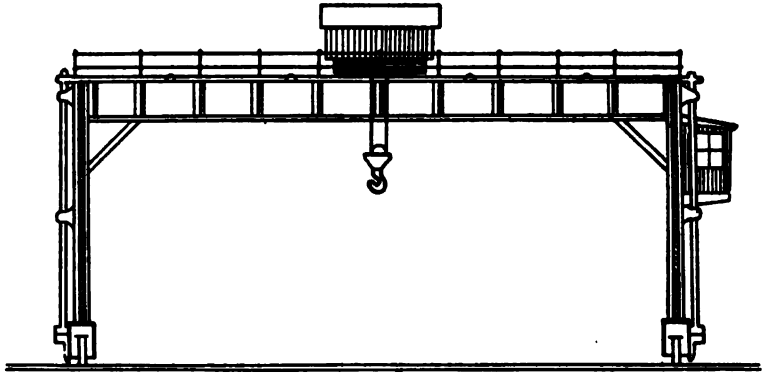


FIG. 69.—A GANTRY CRANE WITH TRAVELING HOIST. (*Courtesy of Terry.*)

the interest of this study centers, are of several varieties. There are two sets of names, those applying to or modifying the word "gantry" and those modifying the word "crane." There are two principal types of gantries: (1) portal or full-arch, and (2) semiportal or half-arch. Both types are usually "traveling" and run on tracks along the wharf front.

The Full-arch Gantry Crane.—The full-arch gantry revolving jib crane shown in Figure 70 (Shepard Electric Crane & Hoist Company) may be analyzed as follows:

The gantry itself is a full-arch, as it has both feet on the ground, and it is called also a "portal" because it looks like a gateway. Mounted upon this gantry is a revolving crane. The hoisting machinery and the revolving and locomotion mechanism are contained in the cab. This cab is mounted on trucks that revolve on a

small circular track. The jib of the crane is fixed, that is, it cannot be moved up or down.

The crane is a traveling crane, as may be seen by the drawing, that is, the gantry is mounted on wheels and the crane is capable of moving itself along the rails on the wharf apron.

Figure 71 shows a traveling *semiportal gantry revolving jib crane.* The only difference as to type between this crane and the one

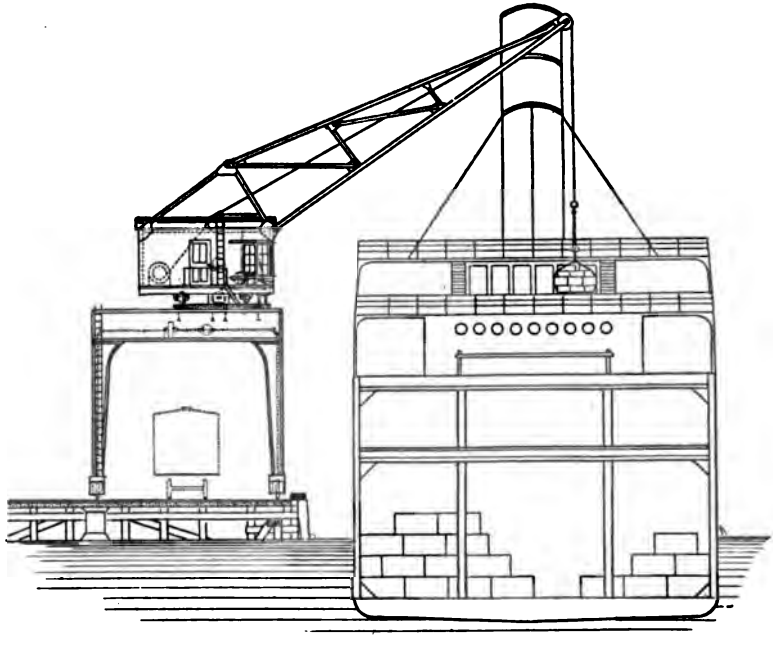


FIG. 70.—A FULL-ARCH GANTRY REVOLVING JIB CRANE. (*Courtesy Shepard Electric Crane & Hoist Co.*)

just described is in the shape of the gantry. In this case the gantry has one vertical leg and one horizontal leg. The inshore end of the horizontal leg with its traveling wheel rests upon a rail that extends along the face of the wharf shed. This rail is mounted on brackets attached to the vertical columns, as in the case of shop crane rails. The full-arch gantry crane is usually on wharves that have no sheds. Compared with a locomotive crane, its advantage is that it occupies less space on the wharf. By putting the hoisting machinery up on a gantry there need be kept open only the two crane rails, leaving

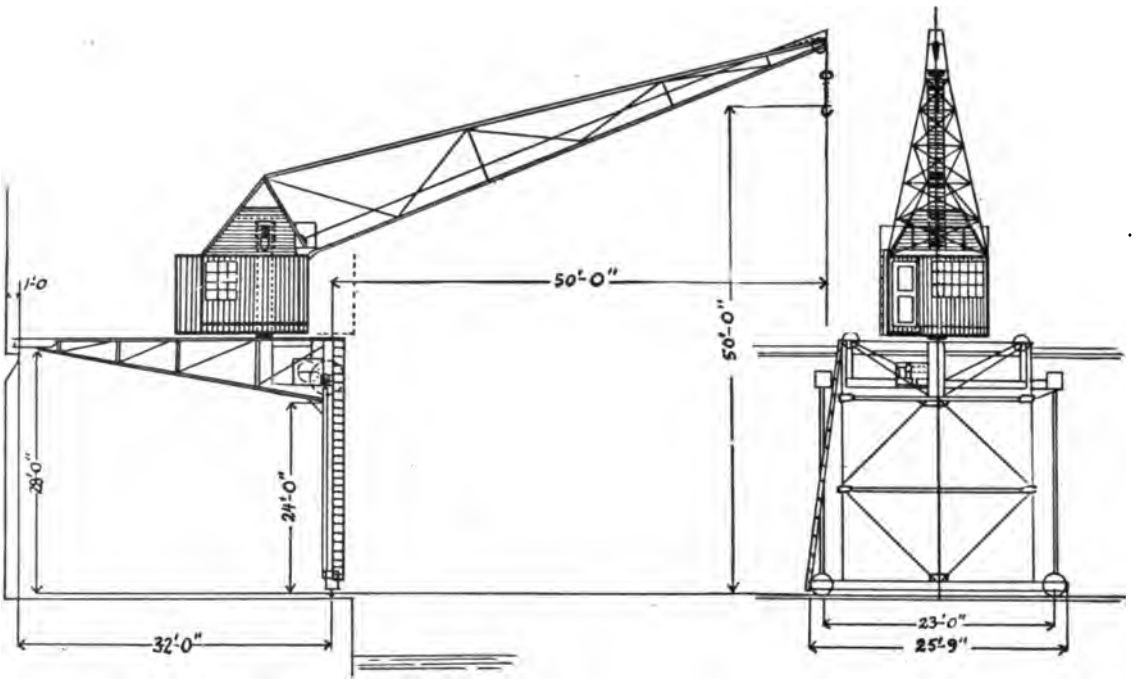


FIG. 71.—HALF-ARCH OR SEMIPORTAL GANTRY REVOLVING JIB CRANE WITH FIXED JIB. Light duty wharf crane type. Capacity 2 to 5 tons. (*Courtesy of Heyl & Patterson, Inc.*)

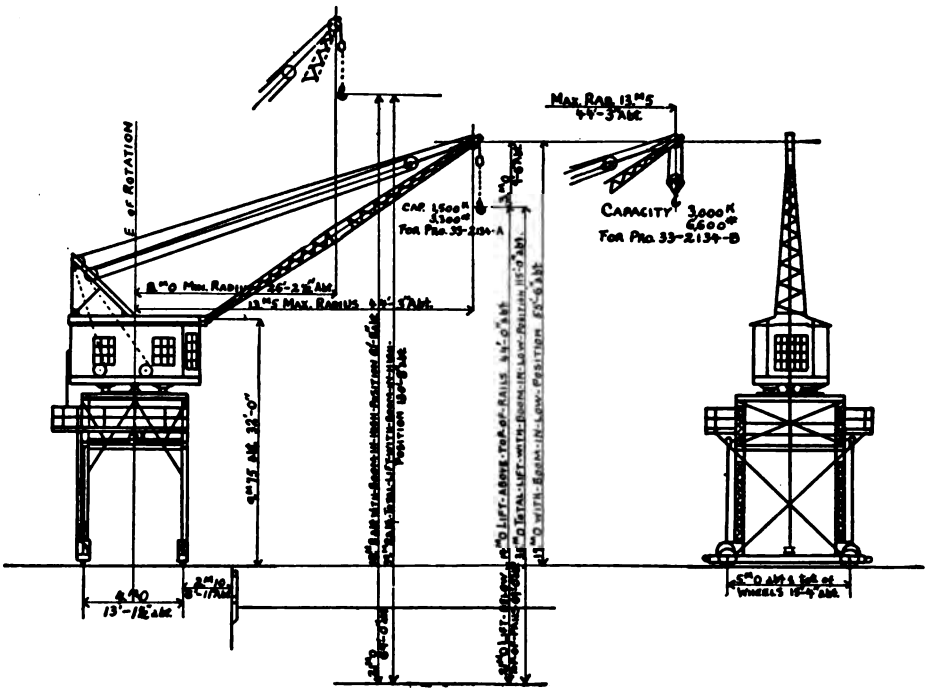


FIG. 72.—A LIGHT-DUTY FULL-ARCH (PORTAL) GANTRY REVOLVING JIB CRANE WITH HINGED BOOM.
(Courtesy Wellman-Seaver-Morgan Co.)

space for railroad cars and tracks to pass under the crane, or space for depositing merchandise.

When there is a wharf shed, the semiportal gantry has a further advantage, because putting the crane rail along the face of the shed removes from the working area both inside legs of the crane itself and the space occupied by the rail, leaving this space free for cargo handling. In practically all modern ports the accepted type of

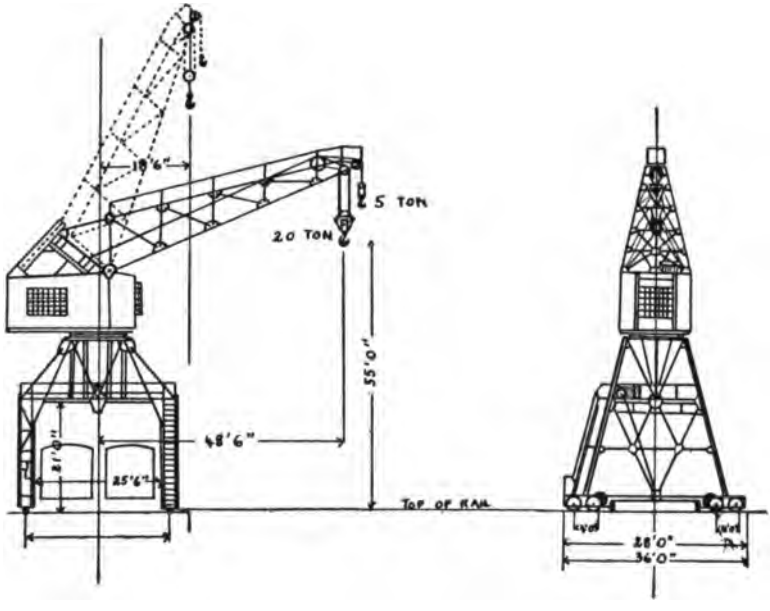


FIG. 73.—A HEAVY-DUTY FULL-ARCH GANTRY REVOLVING CRANE WITH A HINGED BOOM. (*Courtesy Heyl & Patterson.*)

crane is the semiportal gantry revolving jib crane. Light-duty cranes are usually constructed with a fixed boom.

Hinged-boom Traveling Semiportal Gantry Crane.—This crane, shown in Figure 72, differs from the preceding only in that the boom is movable or adjustable instead of fixed. Four such cranes mounted on semiportal gantries were built at the Army Supply Base in Boston and constitute one of the most modern types of wharf equipment in the United States.

Figure 73 illustrates a *full-portal gantry revolving jib crane with a hinged boom.* This particular crane is built for heavy duty, 20 tons capacity, and the jib, being hinged, may be elevated almost to

the perpendicular. This is the usual type of heavy-duty open-wharf installation.

All gantry wharf cranes revolve.

Light-duty cranes of two to three tons capacity are being preferred more and more for the usual miscellaneous cargo transfer between ship and wharf. The principal reason for this is the lower cost of construction for each individual crane and the lower cost of power and operation. Each cycle usually requires about forty-five seconds. Starting with the boom inshore we have (1) lifting the draft, (2) revolving the boom and draft through approximately 90 degrees to a point above the hatch, (3) lowering the draft into the

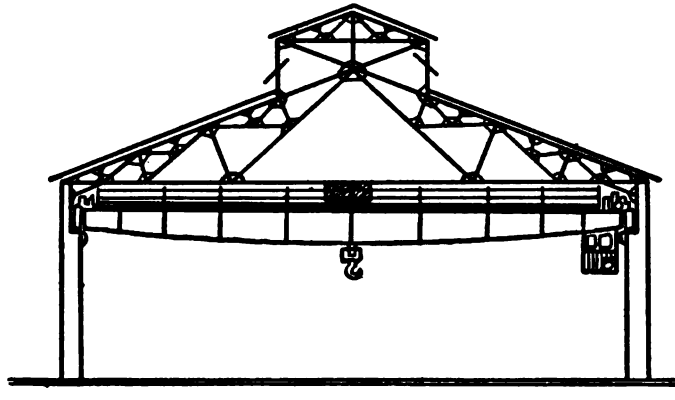


FIG. 74.—SHOP CRANE. (*Courtesy of Terry.*)

hold, (4) raising the hook, (5) revolving the empty hook back again to above the picking-up point, and (6) lowering the hook to receive the next draft. In each cycle the crane must start and stop twice. If a crane is very heavy there is much more inertia to be overcome in starting as compared with a light crane, and also the momentum that must be checked by the brake when the point of rest has been reached is much greater. For many years the prevailing type of crane in most European ports was approximately three tons, but the more advanced harbor engineers in the United States, advocate a one and one-half or two ton crane for the usual wharf transfer work.

Shop Crane.—The shop crane is the familiar crane for inside work. Shop cranes, unless otherwise stated, are understood to be

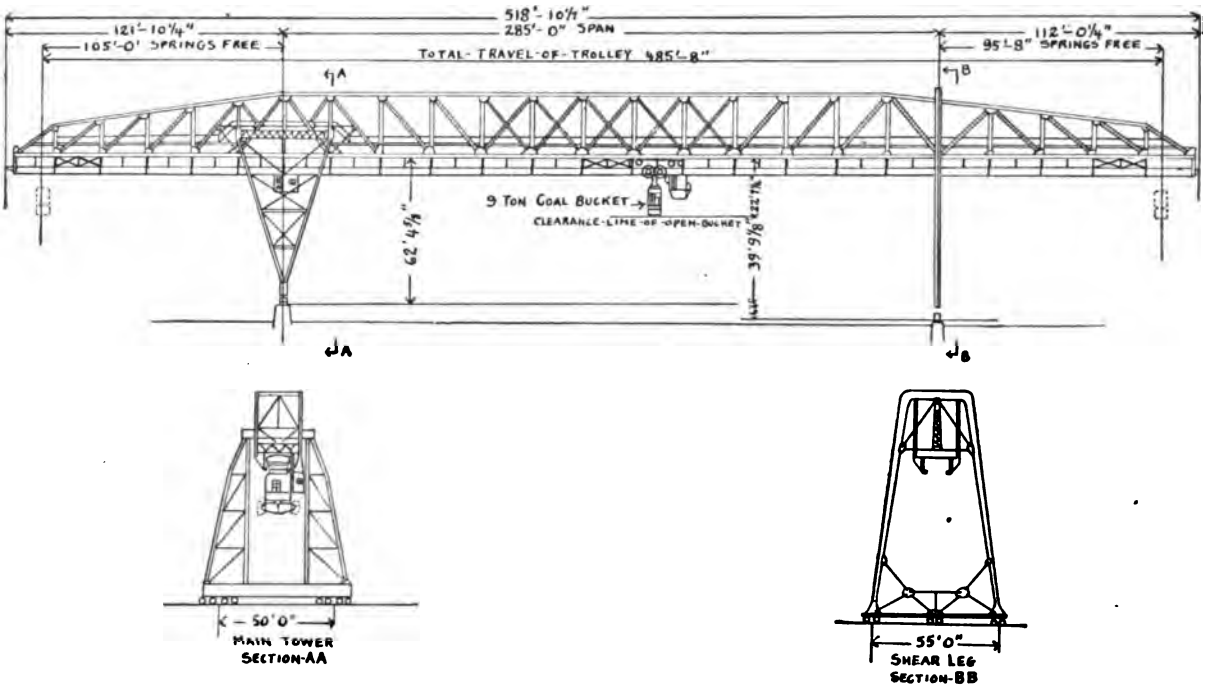


FIG. 75.—A BRIDGE CRANE. Capacity unloading coal, 400 tons per hour. (*Courtesy Wellman-Seaver-Morgan Co.*)

traveling shop cranes. They consist of a bridge extending across the bay of a shop or a wharf shed of a warehouse and resting on rails mounted on the roof-supporting columns on the sides of the bay. These cranes travel along the rails at the space spanning the bay. A carriage with the requisite winding mechanism and hook travels from one end of the bridge to the other. By moving the bridge the length of the shop, and moving the carriage with the hook crosswise on the bridge, every square foot of floor space in the bay in which the crane works can be covered.

Heavy-duty Cranes.—It is obvious that if cranes are designed for operation at low capacity in favor of rapid movement and economy of current consumption, other provisions must be made to handle the heavy cargo.

As has been pointed out in this work and elsewhere, it is found to be more advantageous to run flat cars or gondola cars, loaded with heavy articles, to an uncovered wharf fitted with car tracks and heavy-duty cranes or derricks and discharge the cars on to a lighter. The large packages are transferred by the heavy-duty wharf crane to a lighter. The lighter is towed alongside the ship and a heavy-duty floating derrick puts the heavy packages of merchandise into the hold from the water side. This has the advantage of centralizing the relatively occasional utilization of the heavy hoisting equipment at two points, uncovered wharf and floating derrick, making it "rentable" or a paying investment. There should be an uncovered heavy-duty wharf crane for every ten or twelve to twenty general merchandise berths. This system also has the further advantage of not congesting the wharves with large and bulky packages and leaving ship's tackle or wharf cranes entirely for the lighter packages.

The floating derricks or floating cranes are simply the usual types of cranes mounted on heavy floats. The favorite form in New York is a stiff-leg or A-frame derrick mounted on a float.

Bridge Crane.—The bridge crane, which has reached its best development in the ore and coal stock piles of the Great Lakes, is simply a glorified traveling gantry crane with a cantilever extension. The pendent, or grab bucket, is on a traveling carriage on rails underneath the bridge, rather than a jib or boom or other revolving crane structure resting on the gantry. The usual wharf gantry crane spans from 10 to 40 feet, while the bridge crane may span

several hundred feet. The water end is hinged and is drawn up, in order not to foul the spars or rigging of a vessel entering her berth, and lowered over the hatch when the ship is made fast. The carriage travels along the underside of the bridge from above the hatch to the point of deposit.

The particular advantage of a bridge crane is its ability to

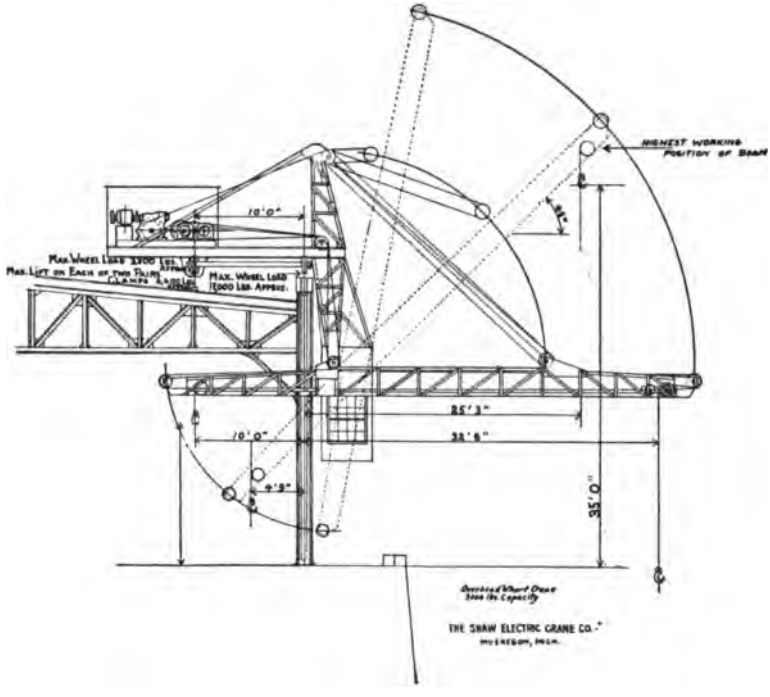


FIG. 76.—A STRAIGHT-LINE WHARF CRANE. (*Courtesy Shaw Electric Crane Co., Manning, Maxwell & Moor, Inc.*)

handle heavy articles from an open wharf directly into a vessel. For instance, an open wharf may be used for storing large quantities of barrels of oil, crates of automobiles, or for ordnance. The new Army Supply Base at Boston has an open wharf, but the bridge crane has not been installed. The East Harbor at Berlin, on the River Spree, has such a bridge crane for handling building materials, particularly bricks, which are loaded at the brickyard into the containers that are placed upon the barge. The movable body

is transferred by the bridge crane and placed upon the chassis of a motor truck. At Brussels, in Belgium, the harbor equipment includes a very excellent bridge crane for handling plate glass from the railroad cars to water craft.

A characteristic of the bridge crane is its greater span in heavy-duty uncovered wharf work. The fact that the hoisting apparatus with the hook runs in a straight line from above the hatch instead of revolving at the end of a boom is conducive to rapid work with little lost motion.

Roof cranes, as found at Liverpool and elsewhere, are simply the usual electric revolving jib crane mounted on the roof of a warehouse or wharf shed instead of on a gantry; or, to put it another way, the roof is the gantry.

Straight-line Crane.—One of the latest developments in crane construction, an example of which is to be found on Pier 6 of the East River—one of the New York terminals of the New York State Barge Canal—is the straight-line crane. This crane is quite different from the other forms that have been mentioned but is of the bridge-crane family. The supporting carriage travels along the roof, but the boom, instead of being hinged at one end, is hinged near the middle and supported by a stirrup dropped from the carriage to a level that permits one end of the boom to extend into the wharf shed. The boom may be drawn up to an almost vertical position, and when lowered one end extends over the hatch of the vessel and the other end extends into the shed. The crane does not revolve but the hook and hoisting carriage travel back and forth in a straight line as in the case of a bridge crane. This gives the rig the name of the straight-line wharf crane. The advantages claimed for this type are several: less dead-weight movement, as only the hoisting drum and carriage, not the entire crane, moves; travel in straight line instead of through an arc of a circle, thus permitting more cranes to work on a single vessel without interference with one another; a larger area for deposit or picking up of drafts, thus relieving congestion at one of the principal points of congestion; transfer from hold directly to within the transit shed, thus permitting the men to work under cover in bad weather. This type requires an especially high transit shed to enable the boom to clear the ship's rail and still extend into the shed.

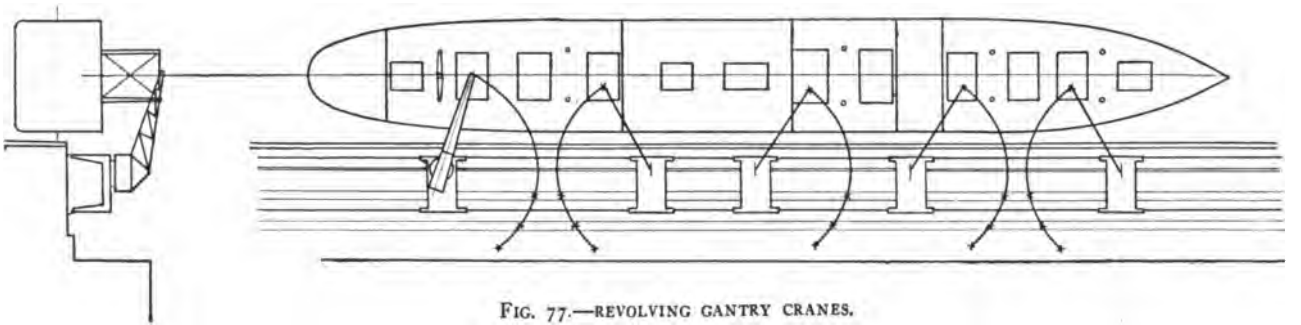


FIG. 77.—REVOLVING GANTRY CRANES.

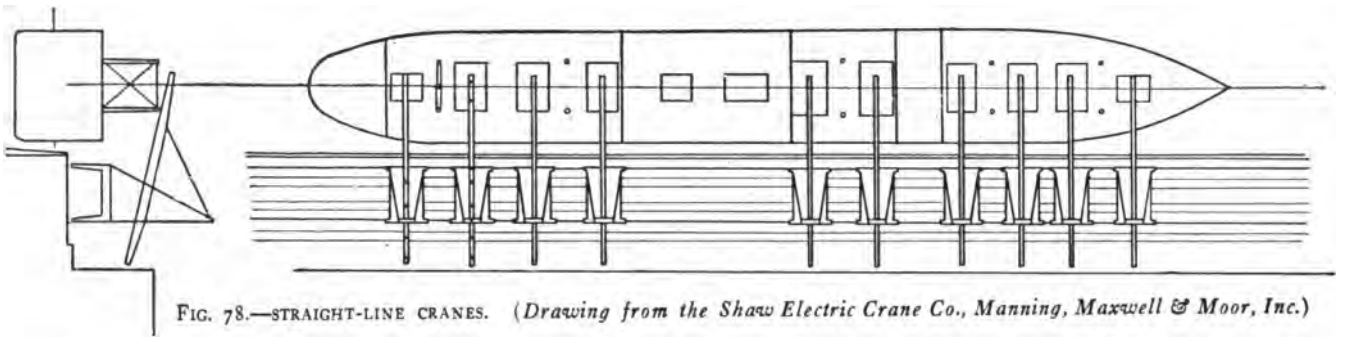


FIG. 78.—STRAIGHT-LINE CRANES. (*Drawing from the Shaw Electric Crane Co., Manning, Maxwell & Moor, Inc.*)

Relative Advantages of Ship's Tackle and Shore Cranes

Ship's Tackle versus Crane Equipment.—Cranes are expensive to install, and unless the equipment is used almost continuously, that is, unless a large volume of freight is handled per annum, the capital investment causes a disadvantageous overhead as compared with the tackle that the ship must always have with it, whether the cranes are installed at some ports or not.

Cranes occupy a considerable amount of wharf space, and this space is not available on the narrow piers that have become customary in American ports.

The installation of cranes increases the cost of pier construction, as both the pier structure itself and the pier shed must be of sufficient strength to carry the additional load of the crane.

On the narrow American piers that do not have rail connections, one of the chief advantages of the crane is lost—that of loading discharged merchandise on to flat cars and gondola cars after the vessel has left its berth.

The cranes require a great deal of space because of swinging the boom through a large arc. This usually makes it impossible to work more than one fall to the hatch. The cargo-mast and burton-and-fall rig moves the freight in a direct line, and the amount of time saved in the actual passage of the draft between the wharf and the holds is in favor of the ship's tackle and cargo mast rig as against the crane. However, this advantage is slight and depends largely upon the skill of the operators, a crane being more rapid in skillful hands. It takes more energy or power to revolve the entire crane boom and house than to raise the draft and burton it between the wharf and hold.

Many other arguments that are advanced in favor of the American system mean very little. For instance, it is stated that the European steamship companies, when they built the piers in Hoboken, did not copy their own home ports but copied the American port because of the superiority of the New York system. The answer to this, on the other hand, is that the wharves and quays built for these same companies in their home ports in expanding their service were built according to plans of their home ports, not according to the American ports. If the American system is superior, why was it not copied in recent port improvements abroad? This argument is

"fifty-fifty," the answer being, of course, that the prevailing system at either port is followed.

Cranes versus Ship's Tackle.—This caption is misleading, because, while there may be competition or relative merit between the crane system and the ship's tackle system, the functions of the two systems are somewhat different. It will promote a more beneficial argument to consider the two systems as antagonistic.

The advantages of the crane transfer are enumerated as follows: The crane reduces the amount of hard labor, that is, the drum-end man and winch runner is displaced by a man sitting in a protected cab on the crane, who controls the various movements of lifting, lowering, and sluing by means of levers. Also, the crane operator suffers less fatigue than is given by the jar, vibration, and the noise of the winches.

Considerably fewer men are needed in the transfer movement. When cranes alone are used the only member of the crew on the deck of the ship is the gang captain or signal man. One man in the cab of the crane replaces one or two winch runners (one if right-hand and left-hand winches are operated by one man) and one or two drum-end men.

The rigging of the ship's tackle is dispensed with. The crane is always rigged; it only has to move along the rails on which it travels to the point at which it is to work. This is all controlled by a lever in the cab.

The point of deposit on the wharf is larger with the crane than with the burton and fall. The point of deposit for the burton and fall is only about 8 by 10 feet, while that of a crane may be 8 or 10 feet wide and 20 to 30 feet long. Congestion is relieved at the point of deposit, because it is possible to put down a second draft before the first draft is completely cleared away and because the longshoremen can work continuously along the area without having a draft "hang" or remain suspended above them while the preceding draft is being removed.

The crane is usually in a better mechanical condition and more workable than the ship's winch, due to the exposed position of the ship's winches, the working of a vessel in a heavy sea, carelessness of casual operators, and other circumstances. The steam fittings of the winch are often loose, steam is lost, or the winch itself becomes out of alignment. Aside from the lack of efficiency due to steam

condensation and leakage, the noise that the ship's winches make indicates the amount of energy that is being expended in making that noise. The noiseless operation of a well designed and constructed electric crane indicates by its silence the efficiency of the application of power to the work.

Electric power has an additional advantage over steam in that the current is consumed only when the crane is actually in operation, while the winches on a ship must be kept under steam continuously during their use, whether they are in actual operation or not.

When the ship leaves its berth it takes its equipment with it, leaving the wharf without equipment. With a crane, barges, lighters, and other harbor, river, and inland navigation craft may be served; also railroad flat and gondola cars may be loaded and unloaded by the use of the crane.

The amount of cable or rope consumed is less in the case of the crane. A short steel cable is used, compared with the many feet of rope in the various falls, burtons, etc., in the mast-and-winch system.

Cranes will undergo many changes in type in the next few years. At present it is safe to say that the relative advantage depends upon circumstances—roughly, the crane for a quay wharf and the mast for a pier wharf.

Use of Specialized Equipment[2]

The greater part of the overseas freight of the world is miscellaneous package freight, the equipment for handling which differs but little from that used years ago. But there are other classes of freight whose character is such as to make it readily adaptable to transfer by specialized equipment of various sorts. These classes are *(a)* standardized-package freight, *(b)* free-flowing bulk freight.

By standardized-package freight is meant that which to a predominant degree is shipped in a standardized package in cargo lots or very large shipments. The group includes bananas, sugar, sacked grain, flour, case oil, cotton, coffee, and a great number of other products.

A large part of this standardized-package freight is still handled by methods already described, but specialization of equipment has followed the standardization of package in many instances where the volume of freight has been great. In some cases the specialization has been only an improvement and a standardization of the old

[2] From Thomas R. Taylor, *Stowage of Ship Cargoes.*

methods. By making careful study of a particular situation, stevedores have been able to work out the most advantageous whips, power, size of gang, etc. In other cases a new system of transfer has been devised, this applying specially to the conveyors used for cotton, coffee, and other products at widely separated piers. Since the packages are of uniform size, the value of a conveyor of limited size and power is readily demonstrated. Some of these conveyors extend from the deck to the transit shed; others have legs that can be placed into the hold. The following advantages are claimed[8] for these conveyors and are substantiated in individual cases at least.

1. Speed of loading is increased from 25 to 75 per cent. The speed is increased because there are no points of congestion, as at the place of the deposit of the fall; because the machine is tireless; and because the conveyor belt can be made to average a greater speed than a man.
2. Cost of loading is reduced by as much as 80 per cent in some instances. This cost reduction is largely due to the fewer number of longshoremen required. If the conveyor extends from the hold and includes a tiering section, the number of men employed at a hatch may be cut to one-fifth of the number used under old-style methods. The speed of discharge is increased at the same time, making a large total in expense per ton. On March 6, 1919, 2,103 barrels of asphalt were unloaded by a conveyor system at Beaumont, Texas, in 8½ hours at a total cost of $25.16.
3. Damage to cargo is eliminated to a large degree. This applies to sugar, coffee, flour, etc., in bags, that are torn by the slings, skids, or banging against obstructions on wharf or ship. With certain commodities there is little or no elimination of damage. The greatest damage to sugar, for example, is in the tearing of the bags by the longshoremen's hooks, and the conveyor will not remedy this. With the commodities, such as bananas, that are bruised in slings and therefore must be handled in single bunches by the expensive human chain, the labor saving is very great.

It would seem that these advantages would have led to wider installation of such machinery even for loading miscellaneous freight. Some difficulties have prevented this. The conveyors in the past have not been readily adaptable to varying sizes and weights of packages, and to varying level of the vessel. For some time conveyors could not be economically designed to lift weights at an

[8] "The Coming Mechanical Devices That Will Make Ship-loading Economical." *The American,* Vol. V (1919), 7–15.

angle greater than 45 degrees and therefore could not be placed in the hold. And probably the greater difficulty to be met has been the conservatism of the shipping trade, which looks askance at methods that have been accepted by manufacturing plants many years ago. All these difficulties are being overcome rapidly. Modern conveyors are capable of carrying the average overseas package, which is less than 500 pounds in weight, and of raising these packages at almost any angle. They have proved their practicability at various places and their manufacturers have recently gained more publicity through the Material Handling Machinery Manufacturers' Association, so that it is to be expected that this method of handling freight will be more widely used at ocean terminals in the near future.

Continuous-motion or Belt-conveyor Transfer Equipment.—The horizontal movement by belt conveyor, as often used in certain side-port loading and discharging, is simple and needs little discussion here. But when continuous-motion systems have been attempted for deep holds of ocean-going vessels with a long "rise" or vertical movement out of the hold, and with constant changes in the length of the lift due to tides, and when there is a long carry to the wharf due to the size of the ship, difficulties have been encountered. Obviously, any kind of conveyor system will be limited in practice to certain grades of package freight, particularly those of fairly small dimensions and weight, excluding large and irregularly shaped crates or very heavy objects.

The Banana Unloader.—The banana unloader was one of the first vertical conveyor systems devised in transfer movement for ocean-going vessels. A description of this useful piece of specialized equipment is quoted from *Ports and Terminal Facilities.*[4]

The method of handling in slings did not work well for bananas, as the fruit was bruised. As the banana trade increased in importance throughout the world the terminals of banana steamers at Hamburg, New Orleans, and elsewhere were fitted with a specially devised banana unloader. The most successful type and the one with the greatest capacity has been installed by the Port of New Orleans, the Port of Galveston, and elsewhere. The equipment is described in a booklet issued by Ford, Bacon and Davis, the engi-

[4] R. S. MacElwee, *Ports and Terminal Facilities.* McGraw-Hill Book Co., New York, 1918.

neers designing the municipal wharves, warehouses and elevators at New Orleans, La.

Banana importations at New Orleans exceed those at any other port, amounting for the year ending June 30, 1914, to 16,583,000 bunches, equivalent to an average of 320,000 bunches per week.

The handling of this business by mechanical devices has been developed until practically all of the bananas are now unloaded by machines.

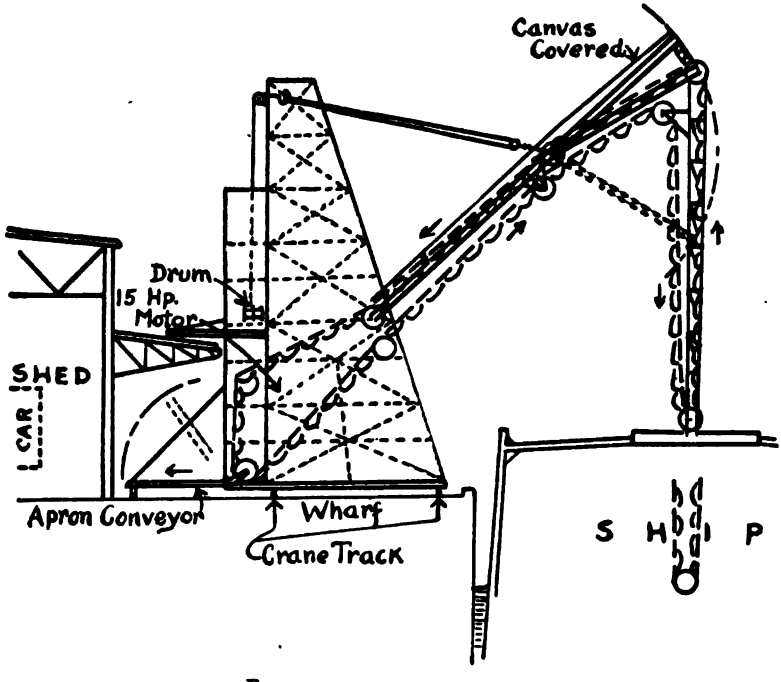


FIG. 79.—BANANA UNLOADER.

The design of this machine is complicated by the necessity of providing for a wide range of water level and ships of various dimensions. The machine consists of a steel A-frame structure traveling lengthwise of the wharf on two rails about 21 foot centers, and carrying a structural steel main boom 50 feet in length, stepped about 20 feet above the dock level.

On this boom, at a distance of about 30 feet from the heel, is stepped an auxiliary boom 20 or more feet in length, from the end of which is swung the vertical leg of the conveyor. These two booms afford almost any desired combination of vertical and horizontal

adjustment, while at the same time the main boom is sufficiently short to clear the stays and wireless rigging of the ships.

These booms and the framework carry the conveyor proper, consisting of two endless chains spaced about five feet apart and running over pairs of sprockets at the foot and head of the conveyor frame, at the pivot points of the auxiliary and main booms and at additional points at the discharge end of the unloader.

The distance between chains is maintained by pipe spreaders and through bolts spaced about three feet centers, attached to which is a four-foot canvas belt with sufficient slack between each pair of spreaders to hold a bunch of bananas when the chain is moving vertically.

Upon reaching the point of discharge the bunch is forced out of the pocket by a roller behind the belt and drops upon a short horizontal conveyor from which the bunches are picked up by hand, inspected, sorted and loaded into cars, or disposed of locally.

The entire machine is driven through gearing and clutches by one 15-H.P. motor. The capacity of each machine is upward of 2,600 bunches per hour.

Three groups of these unloaders, consisting of 10 units, are owned by the Dock Board, the total investment being about $90,000. The most recent installation is at the Pauline Street wharf and consists of four machines costing approximately $37,500. The section of the wharf on which they operate is of pile and timber construction with steel shed, about 360 feet by 260 feet. As the area is covered rain does not interrupt the discharging of cargo. The wharf is served by eight transverse spur tracks accommodating five cars each, and as one ship may carry 40,000 to 45,000 bunches or about 120 carloads, the entire track capacity may be filled and moved three times in less than a day's time. The cost to the Dock Board of this wharf with its shed and tracks was about $1.40 per square foot. In the rear of the wharf the Public Railroad has yard capacity for 200 additional cars.

The Board of Commissioners makes a charge for the use of the banana conveyors of one-fourth cent per bunch, which considerably exceeds the cost of operation, maintenance, and interest charges.

Vertical Belt Conveyors.—The principle involved in the banana conveyor, that of the slack belt between rigid cross pieces and the three-ply leg to make possible accommodation to the variable depth of ships and water level, is suggestive for other unloaders. It is perfectly feasible to unload coffee or sugar bags in the same manner. In fact, any regular bag-shaped or bunch-shaped articles which will

not injure the belting could be handled by this apron, or slack-belt system. The increase in the speed of unloading by the mere feeding

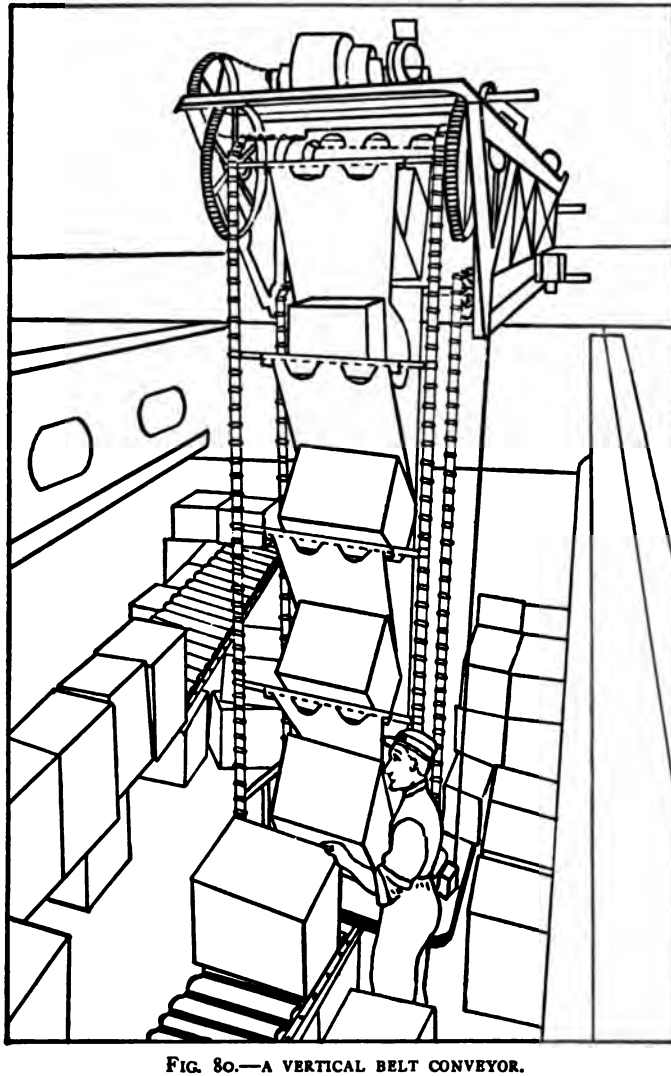


FIG. 80.—A VERTICAL BELT CONVEYOR.

of single bags to an elevating conveyor is very marked. The great trouble heretofore has been that conveyors would work horizontally and at a low grade, usually not exceeding 45 degrees, but could not possibly perform a vertical lift and a horizontal transfer.

The Elevator Conveyor.—When the above paragraph concerning vertical belt conveyors was written the writer had not yet seen the type of conveyor for general cargo shown in Figure 80.[5] This conveyor is an application of the slack-belt principle of the banana unloader. Where a large portion of the cargo is made up of compact boxes, bags, or crates, not exceeding 300 to 500 pounds, it is of considerable advantage. A similar system, using iron baskets instead of a slack belt, is in general use on the London wharves for discharging frozen mutton.

In connection with the conveyor it should be noted that the

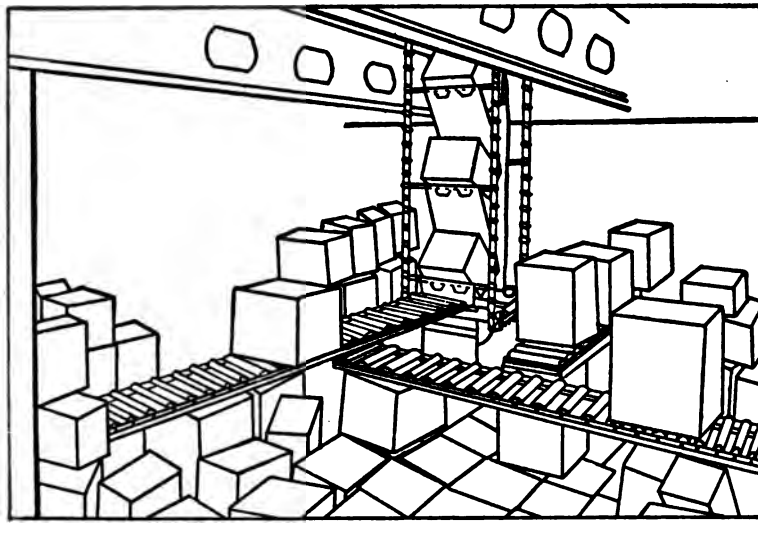


FIG. 81.—LOADING SHIP BY MEANS OF A VERTICAL BELT CONVEYOR AND GRAVITY ROLLER CONVEYORS TO THE WINGS.

distribution of the cargo from under the hatch to the corners of the hold where it is stowed, or the reverse, is made by light gravity roller conveyors. This expedites the stowage of the cargo and makes unnecessary the time-consuming trip back and forth between the sling in the hatch opening and the corners of the hold that are being stowed. With these rollers it is possible to chute the packages to two, three, or four different corners in the hold and keep several stowage crews busy in that manner.

[5] By courtesy of Rownson, Drew & Clydesdale, Inc., New York, London, and Glasgow.

It must not be overlooked in all devices for rapidly loading vessels that the speed of transfer is limited by the ability of the hatch gang properly to stow the merchandise. And in discharging it is limited by the ability of the hatch gang to break out the cargo and swing it to the hatch opening and make it into a sling or feed it into the conveyor. Again, at the point of deposit on the wharf, in discharging, the same question of taking the draft away quickly is of the greatest importance in the rapid transfer movement.

In all events, the stowage, handling, and transfer must be so synchronized that the draft is never allowed to hang. In the case of the conveyor the parallel of allowing the draft to hang is having to stop the conveyor because it is delivering the merchandise too rapidly.

All conveyor types of transfer have the advantages of direct-line motion over the arc of the revolving crane boom, in addition to the advantage of continuous motion, rather than the intermittent motion of the hook and sling system.

With the large hatch opening of the newer type of cargo vessels, two falls can be worked at one time. In fact, under certain conditions, four falls may be operated, two from offshore, and two from water side.

Free-flowing Bulk Freight.—Bulk freight consists of articles that are shipped without packaging and includes brick, ore, coal, grain, lumber, oil, etc. Of these commodities some, such as brick and lumber, are non-flowing and cannot be handled essentially differently from miscellaneous package freight; others, such as oil, grain, coal and ore, are free-flowing and are adapted to transfer by specialized equipment. Grain is poured into vessels from hoppers fed by conveyors. Iron ore is also poured in the holds of its carriers and is unloaded by grab buckets, Huellet unloaders, or other specialized means. Coal cars are lifted bodily and the contents dumped into the waiting vessel. Oil is pumped in and out of the especially designed tankers. Mechanical conveyors carry phosphate rock in Florida from the storage pile to the hatch coamings.

Two general principles are applied in these devices. One is that it is cheaper to lift mechanically free-flowing goods to a point from which they can flow into the carrier than it is to transfer them horizontally. The other principle, closely associated with the first, is that mechanical hoisting is economical with goods in large volume

and of a nature not destructible by rough handling. These two principles are so well tried by practice that they are generally accepted. Their application, however, differs with the commodity and with other conditions, and no attempt will be made here to describe the different appliances that are used. Any one interested in the methods may find excellent descriptions of ore-carrying on the Great Lakes, of the coal-car tippers at New York or other points, of grain elevators, such as those at Girard Point, Philadelphia, and of the filling and emptying of the tankers at any oil exporting or importing port.

It must be said that the application is being extended to cover the transfer of some commodities that are put up in packages. Thus the Arbuckle Coffee Company at New York uses a chute delivery to ship for its coffee sacks. There seems to be no adequate reason why the gravity and even the grab-bucket systems should not be used for unbreakable commodities that are handled in large volume.[6]

Bunkering or Coaling Ships.—One of the various important and disagreeable duties that a ship must perform in port and also at many ports of call is that of taking aboard fuel. A great advantage of oil fuel is the speed with which the fuel tanks of the ship may be filled by fuel lighters that come alongside and simply pump the fuel from the lighter into the tank of the ship. Unfortunately, the amount of fuel oil available at ports is so limited that only a comparatively small proportion of ships, at the present time, are able to use this convenient fuel.

Bunkering, or taking aboard fuel coal, must be distinguished sharply from loading cargo coal into a vessel that is to carry the coal as freight. At the great coal ports, such as Newport News, Baltimore, Cardiff, Newcastle, and elsewhere, from which coal is shipped as a commodity, elaborate specialized machinery has been installed for loading. Coal piers load directly into colliers for overseas shipments or into barges for distribution along the water front. In recent years the coaling facilities of the world have been so overtaxed that ships desiring bunker coal alone have not been permitted to go to these coal piers for bunkering.

Also a cargo or passenger vessel will find it uneconomical to bunker at the coal piers. Bunkering may be carried on while the vessel is at her berth discharging or receiving cargo, without losing

[6] T. R. Taylor, *Stowage of Ship Cargoes.*

any of the time of the vessel. The ship is usually "breasted off" from a wharf a sufficient distance to permit coal lighters to come between the vessel and the wharf. There are two distinct methods of getting the coal from the lighter into the bunker. The first is by use of the familiar grab bucket carried on a derrick barge of some sort. Except where very large ships are to be bunkered, the so-called gooseneck boom crane, operating a grab bucket that lifts the coal from the barges and drops it into the hoppers that lead to the ship's bunkers, is the more flexible and less expensive method, and also one that saves the time required in rigging other apparatus. At the various anchorages around Hampton Roads this floating equipment is to be seen.

At New York, where very large lighters bunker liners that consume enormous quantities of coal on each trip, there have been developed two systems of belt-conveyors; one by the Michener Stowage Company and the other by the De Mayo Company. Both of these systems are built on the principle of the chain-bucket elevator. They are rigged to the side of the vessel with spouts leading to the bunker ports. The rigging of this equipment takes considerable time, but the rapidity of movement after the rig is once in position shows a great gain in the time and effort necessary to bunker a large ship.

COMPARISON OF COALING METHODS

Tons of coal bunkered...	3000	8000	8000	8000
Stevedores and operators.	950	240	88	96
Avg. tons p.h. per ship..	150	200	400	800
Hours coaling	20	40	20	10
Avg. time per 1000 tons.	6-2/3 hrs.	5 hrs.	2½ hrs.	1¼ hrs.
Avg. tons per laborer p.h.	.157	.833	4.55	8.33
Man hours, labor	19,000	9,600	1,760	960

Mr. H. Michener, Jr., president of the Michener Stowage Company, gives the above table of figures, showing a comparison of coaling vessels at various ports. Although this information is *ex parte*, the figures are, nevertheless, interesting.

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CHAPTER X

STOWAGE AND THE STOWAGE PLAN[1]

Difficulty of Stowing

The stowage of cargo may be said to begin after the goods have been transferred from the pier to the hold, although the term "stowage," properly applied, covers the operations of transfer, as well as the actual packing of the goods in the hold. To a man who has never watched the loading of a vessel, stowing seems a simple matter, but it really is most complicated and difficult. The problems encountered in trying to fix the maximum amount of cargo in the least space, at the least expenditure of time and money, and at a maximum amount of safety to the goods and to the vessel, are not easily solved. This is particularly true with a mixed cargo that is to be discharged at two or more ports. It takes a very capable man to plan the stowage of such a vessel.

Planning the Stowage

Planning by the Booking Agent.—Planning the stowage begins in the office of the steamship company. The billing clerk, in booking the cargo, must take into consideration the relation of different shipments to each other. He must secure a cargo that is well balanced by weight and volume, by size or measurement, and by character. He should not take all dead-weight freight that will bring the vessel to its marks before it is filled, nor should he fail to provide small packages to use as broken stowage, nor should he accept freight that is of a character dangerous to the vessel, crew, or cargo. A new man may make many mistakes that prove very embarrassing and troublesome.

Planning by the Stevedore.—The freight that is accepted is shown on the "cargo list," which is closed as soon as enough cargo

[1] By Thomas R. Taylor.

has been secured. A copy of the list is then sent to the pier superintendent or stevedore in order that he may know what freight to expect and begin the preparation of a stowage plan. The problem of the billing clerk is easy as compared with his, for he has the enormous task of properly arranging the cargo in the vessel. He must consider (1) the speed and cost of loading and unloading, (2) the proper protection of the vessel, (3) the protection of the cargo, and (4) the stowage of the maximum amount of cargo. These principles are relatively easy of statement but their expansion in this and other chapters will show that they offer many problems which are made more difficult by the fact that they are interrelated. Long experience in the business is the only method of training a practical stevedore, for it is experience only that will teach him the relative merits of different possibilities.

With these principles in mind, the stevedore sits down before the cargo list and mentally places the freight in the vessel. He knows the peculiarities of that particular ship and is familiar with the commodities shown on the list. He realizes that he must put about one-third of the dead weight in the between decks in order to prevent excessive rolling of the vessel; that he must place more weight aft than forward because this ship sails better if it has a "drag"; that he cannot load this heavy machinery in No. 3 hold because the beams at that hatch are weak; that clothing cannot be placed on the "skin" because it may be damaged by the water from the leaky tank top; and that the barrels must go in No. 4 hold for the reason that they are already stored at that end of the pier. His mind is full of such limitations on his work, and it is only after he has considered all possibilities that he is ready to draw up a preliminary stowage plan. He may then gather his foremen together to tell them what he plans to do, and they may offer suggestions that will lead to alteration. But even after all this has been done, there is little hope that the stowing will proceed as planned, for delay in receipt of some shipments may upset the whole scheme. The machinery that was to go on the skin of No. 5 hold may not be delivered so early as the canned goods that were to be placed on top of the machinery. Such occurrences are common, so the preliminary stowage plan is subject to constant change.

Upon the completion of the preliminary plan and the arrival of

the vessel, stowing may commence. The hiring of the men and the layout of the transfer equipment have already been described. We are now primarily interested in the way the freight is placed after it is put in the hold and in the completion of the stowage plan.

Methods of Stowing

Preparation of the Hold.—The methods used in stowing the cargo in the hold varies with the type of commodity and with the article, so that no description will hold good for all kinds of freight. The first step in almost any case is the proper preparation of the hold to receive the cargo. In some cases preparation may consist of nothing more than the removal of débris left from the previous voyage, but in other cases, it must be very elaborate. Before stowing bulk grain it is necessary to construct shifting boards, or temporary bulkheads, to confine the grain to a small compartment in order to prevent excessive shifting, and it is also necessary to build "feeders" in the 'tween-deck or in the hatchway. These feeders are simply large hoppers into which grain is placed and from which it can feed into the lower hold as the cargo there settles during the voyage. If the cargo to be carried is especially susceptible to water damage the beams and stanchions must be muffled with cloth or matting to prevent the drops of vapor condensed on them from falling on the cargo. In some instances the hold must be thoroughly scoured and painted to remove odors, dirt, and vermin.

Stowage of Bulk Freight.—Bulk cargo is ordinarily fed into the hold in an almost continuous stream. As long as it continues to fall into the hold, the dust and the danger of flying pieces prevent men from working below, but as soon as the hatch is choked or blocked the longshoremen can crawl down and begin the task of distributing the load. If the cargo consists of grain the longshoremen will descend at the first opportunity with shovels and throw the grain towards the wings as fast as it is delivered to the hatchway. Even with the hatch blocked the dust is so thick that masks must be worn.

If the bulk cargo is light relative to volume the stowage must be carefully done to economize space. Grain and similar commodities should be tramped down firmly and the interbeam space must be

filled by strenuous work with the shovels. Heavier bulk cargo requires less trimming, for stability considerations require that it be heaped toward the hatch in about the same position in which it naturally falls.

Stowage of Package Freight.—Package freight of all kinds is stowed differently. This ordinarily arrives in the hold in slings. There must be men in the hold to release the draft from the sling, attach an empty sling to the fall, and move the draft to its place of stowage. If the vessel is large and the hatch small, it may be necessary to move the freight fifty feet or more and then to elevate it and stow it carefully in the proper place. These operations require the labor of from 30 to 75 per cent of the total force working on the vessel, and the hold cost probably averages about 40 per cent of the total cost of stevedoring. On account of the short distances and the care that must be exercised in placing the goods, machinery is used but very little. The draft, while still attached to the fall, is swung and dropped as near as possible to its place of stowage. From this point it is rolled, pushed, carried, tossed or dragged to the wings or bulkhead. The longshore hook, with which every longshoreman is armed, is surprisingly useful in this work. If the packages are small a sliding board is fitted up, upon which the goods may be slid for a distance of several yards.

Mechanical Aids.—Planks are laid down in many cases, especially when handling barrels, to assist the movement. Rollers are placed under a very heavy package, and if the longshoremen cannot handle it even then, the deck winch may be called into play by running a rope from it to a pulley in the wing and thence to the weight to be moved. If the packages are sacks of refined sugar or some other easily handled commodity, it is frequently the practice to build up a "stool" or platform at the hatchway, to which the longshoremen may come to receive the packages on their backs. Thus, mechanical aids of various kinds are used, but stowing is primarily a matter of hand labor. It is not only laborious but it is also skilled hand labor, for the operation does not consist solely of moving packages from one point to another. The skill is shown in placing the packages quickly in such a manner that they will occupy the least possible space and will receive minimum damage during the voyage. The longshoreman who can stand at the hatchway and throw a sack of sugar from his shoulders or hip for a distance of six feet in any

direction and make that sack fall exactly in the proper place with the exact amount of momentum necessary is a skilled laborer. Any one who has watched a capable barrel man at work can appreciate his skill. He rolls the barrel easily along the cant line of the tier of barrels below, brings it up sharply at the proper point, spins it rapidly with his hook to bring the bung to such a position that it will be uppermost when the barrel is placed, turns it easily and quickly so that its bilge drops exactly into the cant line of the barrels underneath and the chimes engage exactly with the chimes of the barrel in the same "longer," and finally places a piece or two of dunnage at just the proper points. There is no hesitation, no wasted energy, no smashing of barrels against each other. Every movement is smooth and graceful, and no movement is wasted. The only part of the operation that sometimes delays him is the placing of the dunnage, for if the stability of the barrels does not satisfy him he may move several of them at great effort in order that they may fit snugly and that the amount of dunnage used be reduced to a minimum. He does his work with such apparent ease that it is hard to realize that he is stowing several times the number of barrels stowed by the clumsy, perspiring beginner in the same hold.

Dunnage.—In stowing almost any kind of cargo, dunnage and goods for broken stowage are important considerations. "Dunnage" consists of material used to protect the goods against any possible source of damage. Ordinarily the term is applied only to cheap cordwood used to hold the freight away from the sides, the "skin," or other parts of the ship, and to separate and make stable individual packages; but in the broader sense dunnage includes matting, shingle, and other materials used for these purposes. *"Broken stowage" is the space lost between units of cargo.* It varies with the kind of freight from about 2 per cent to about 30 per cent of the total cargo space, the average perhaps being 10 to 12 per cent. Most of the spaces so left between units must be filled either with dunnage or with small packages in order that the cargo may carry safely. If small packages are used more freight is earned and the cost of dunnage is lowered, so that the booking clerk should endeavor to secure goods that may be used for this purpose. No matter whether dunnage or goods for broken stowage are used, they should be delivered to the hold at the proper time, even though this may mean an interruption in the transfer operations. If the longshoremen do not have them

when needed, time is lost later, and the cargo will probably be in danger of chafe and shifting.

Size of Hold Gangs.—The number and distribution of men in the hold gang will vary with many factors, but principally with the type of commodity handled and with the amount of working space. The numbers will be largest in "flooring off" a large hold, and smallest in "rounding off" or "finishing" a small hold. If the movement from hatchway to wing is different a great many men must be used, and the same is true if the placing of the goods require much time, as in dunnaging fragile goods or in screwing cotton. In some cases the hold gang acts as a unit, as when bananas are passed from hand to hand; but more often the gang is subdivided into units of two or three men each. One or two men will stand in the square of the hatch to swing the draft in the proper direction and to release the sling. There may be ten other men in the hold working in pairs. Each pair receives a draft in turn, moves it to its proper place, and stows it securely. As the hold is gradually filled, the distances become less and the working space more cramped, so that some of the men are released or are sent to another hold. Because of this continual change in working conditions and because of the inevitable interruptions in transferring the goods to the hold, it is very difficult for the foreman in charge of the stowage to keep the hold gang at top efficiency.

It is not customary to carry on the stowage of the hold and the between decks simultaneously, although this may be done. Ordinarily the hold is filled first and then the between-deck hatch cover is put on and used as a new landing stage. However, if the hold cargo cannot be stowed as fast as delivery can be made, alternate drafts may be stopped at the level of the between deck and pulled in by means of a hook and rope.

As the stowing proceeds, the stevedore, through his foremen, must keep in constant touch with the situation. It may be that the goods occupy more space than was allowed for in the calculations, or that the space designed for certain freight must be used for other goods because of delayed delivery. The men may be withdrawn from the hold before the completion of stowing there in order to load other goods in the between decks, or they may be temporarily released pending the receipt of more freight. The whole process is subject to constant change, and it is only after many difficulties have been

surmounted that the holds are rounded off and the hatch covers placed.

Drawing Up the Stowage Plan.—The tally clerks have kept a record of each article transferred and the foremen know where the articles are placed. It is therefore an easy matter for the stevedore or his clerk to draw up a stowage plan. A stowage blank shows an outline of a ship and upon this the clerk first draws lines to represent decks and bulkheads. With the space thus subdivided and with the information given by the tally clerks and the foremen, he can show on the plan the exact place of stowage of each shipment.

Discussion of Sample Stowage Plans—*Saluda.*—Figure 26 shows the stowage plan of the *Saluda* on a voyage from Philadelphia to Liverpool. This is a form that is used for all vessels belonging to the United States Shipping Board, and it gives more information than is contained on the stowage plans used by most operators. The interesting facts in connection with this plan are given under the heading "Remarks." It will be noted that there is no free space in the steamer, despite the fact that the total dead weight on board is only 7,312 tons and the cargo measures only 342,865 cubic feet, whereas the vessel is supposed to carry 7,500 dead-weight tons and has a bale capacity [2] of 373,200 cubic feet. The difference between the measurement of the cargo and the capacity of the vessel is the amount of space that is lost. On this cargo, therefore, the "broken stowage" was 30,365 cubic feet or less than 9 per cent of the total measurement of the cargo. This percentage should be increased somewhat, however, because part of the cargo has been placed on deck, and deck space is not included in the statement of the bale capacity.

Selected 23,000-*Ton Steamer.*—Figure 82 is the stowage plan of a combination freight and passenger vessel of 23,000 dead-weight tons. Sections have been drawn also in order to show the way in which the cargo is stowed.

Note the method of stowing barrels. Their lengths are fore-and-aft because they are placed more easily and carry better in this position. A row of barrels fore-and-aft is called a "longer." The bilges of the upper tier of barrels fit into the cant lines of the lower tier at the quarters. This economizes space and gives stability. The bungs

[2] Bale capacity is less than grain capacity because the grain fills in places that would be lost as "broken stowage" in stowing bales or boxes.

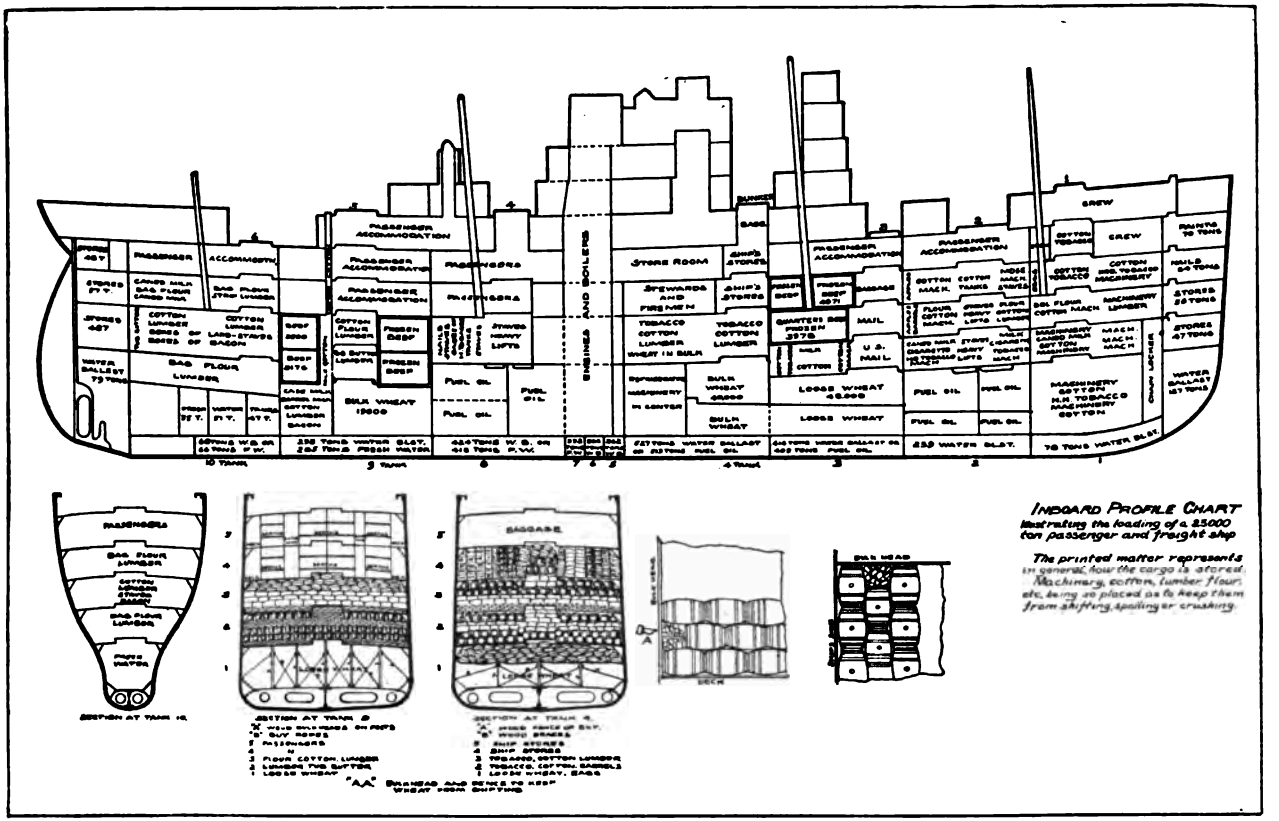

FIG. 82.—STOWAGE PLAN OF COMBINATION VESSEL.

of the barrels are up so as to prevent leakage. Dunnage is placed in spaces too small for barrels. The bilges of the lower tier of barrels are raised off the floor by placing "beds" (small sticks of wood) under the quarters. This puts the weight upon the quarters, which are the strongest parts of the barrels. The numbers of tiers allowed will depend upon the strength of the barrels and the nature of their contents, but in any case it should not exceed eight. This method of stowing is spoken of as "bilge and cant line; bungs up and bilge free."

Sections of tanks No. 4 and No. 9 show the method of placing shifting boards in bulk wheat. The "boards" are really fore-and-aft partitions held in place by shores or guy ropes. Many small holds are fitted with only one shifting board, dividing the space into two equal parts, but large holds, such as these are divided into four or six sections. The shifting of the grain is thus confined to a small area and does not cause instability of the vessel.

Note the manner of placing tubs of butter. Space would be economized by stowing every other tub upon its head, but this would cause leakage and cannot be done.

The extensive use of lumber to separate different commodities and to form a new floor is characteristic. Lumber is placed on the wheat to make a base for the butter, and it separates cotton from butter in No. 9 tank and cotton from tobacco in No. 4. In almost all cases it is advisable to secure lumber as part of the cargo, for it will avoid the extensive use of dunnage, on which freight is not paid. Articles which can be used as dunnage or for filling broken stowage are frequently accepted at a lower freight rate.

It is easily seen that the stowage of a vessel with such a large number of decks and bulkheads is difficult from the mechanical point of view, but the separation of commodities is facilitated. A vessel with no between decks and only a few holds can be filled rapidly by the transfer equipment, but the goods do not carry well because they are jumbled together.

Portsmouth.—Figure 83 shows the stowage plan of the *Portsmouth* sailing from Philadelphia to Montevideo, La Plata, and Buenos Aires. When cargo is to be discharged at two or more ports, the stowage becomes more difficult, for one more problem is added. The cargo destined for the first port should be accessible without disturbing cargo for the other ports. Moreover, the vessel must be

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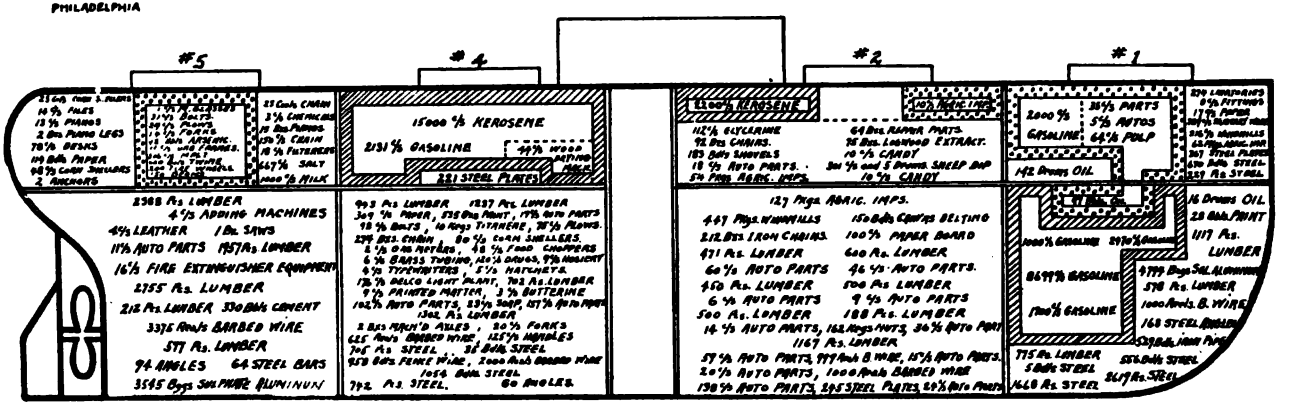
Plan of the Cargo shipped on board the Steamer PORTSMOUTH Captain

for MONTEVIDEO, LA PLATA, BUENOS AIRES, from PHILADELPHIA sailed DECEMBER 5, 1909.



NOTE :-

1. All Montevideo and La Plata cargo can be discharged without disturbing Buenos Aires cargo.
2. Montevideo and La Plata cargo scattered to facilitate discharge and to keep the vessel in trim.
3. Use of lumber in flooring off and in separating consignments.
4. Stowage of steel in 'tween decks to prevent excessive rolling of vessel.

FIG. 83.—STOWAGE PLAN OF S. S. *PORTSMOUTH*, MAKING TWO PORTS OF CALL.

seaworthy after the removal of cargo at the first port. In addition, the distribution of goods in the different holds must be such that discharge is facilitated. All of the cargo for Montevideo cannot be placed in one hold, because it would take a long time to discharge it through one hatch and because the vessel would probably be unseaworthy after the discharge. For these reasons, the consignments for Montevideo are placed in holds 1, 2, and 3, and those for La Plata in holds 1, 2, and 4. At each port, therefore, discharge can be conducted through three hatches at the same time. In no case is it necessary to move La Plata cargo in order to get at Montevideo cargo, or to move Buenos Aires cargo to reach La Plata cargo. Cargo for the first two ports is so evenly divided between the holds that the vessel continues to be seaworthy on the different "legs" of its voyage.

On this stowage plan, as well as on the others considered, the use of lumber in flooring off and in separating consignments is noticeable.

As will be shown in Chapter XI it is desirable to have a large part of the weight of the cargo low in the vessel in order to insure stability, but too little weight near the top causes the vessel to roll heavily. Therefore, some of the dead-weight cargo should be placed high in the hold or in the 'tween decks. This principle has been followed on the *Portsmouth* by putting steel and other heavy materials in the 'tween decks.

CHAPTER XI

STOWAGE AND STOWAGE FACTORS[1]

Desirability of Getting Full Cargo Paying High Rates.—The larger the cargo carried, the higher will be the earnings of the voyage. The overhead cost of the vessel goes on continuously; earnings are made only according to the amount of freight, passengers, and mail carried. The freight agent therefore tries to secure a full cargo paying the highest freight rates. Two questions immediately arise from this statement: What is a full cargo? What freight pays the highest rates?

Commodities Paying High Rates.—The complete answer to the second question is considered in another volume of this series. It is sufficient to point out here that ocean freight rates are determined by many factors, such as competitive conditions, cost of service, value of service, value of the commodity, and nature of the commodity. The factor that is of particular interest here is the nature of the commodity. A dangerous article will ordinarily be charged a higher rate than one which is perfectly safe, and, in the long run, articles that do not fit the requirements of the vessel must pay more than those which do. This presents a question as to what sort of commodity does fulfill the requirements of the vessel, and the answer to that also shows us what a full cargo is.

Getting a Full Cargo.—The ideal commodity is one that fills all the cargo space and lowers the vessel to its "marks." The amount of cargo space is measured according to well-defined rules and is expressed in cubic feet. Two capacities at least are given for each vessel—the bale capacity and the grain capacity. In measuring the grain capacity no deductions are made for loss of space around small obstructions, for it is assumed that the grain will flow into all corners and completely fill the holds. Bales and boxes, however, will not fit snugly into all parts of the hold, and deductions must therefore be made. A vessel of 7,000 tons dead weight may have a grain capacity of 370,000 cubic feet and a bale capacity of 340,000 cubic feet.

[1] By Thomas R. Taylor.

The owner of this vessel would endeavor to secure a grain cargo measuring 370,000 cubic feet or a general cargo measuring 340,000 cubic feet. He cannot take a greater amount without placing some of it on deck, and he does not want to take a smaller amount, for space would then be left empty. Empty space means lost revenue, and it also means danger. If the holds are not completely filled there is a possibility that the cargo will shift and toss about, and this shifting damages the goods and may lead to loss of the ship.

But the owner must also consider the weight of the cargo, for he is anxious that the freight taken be heavy enough to lower the vessel to its "deep-load line." The laws of most countries require that each vessel be marked on its sides with circles and lines to represent the maximum draft of the ship at different seasons of the year and on different routes. No cargo shall be put on after the vessel has been lowered to its marks. This requirement is made because it has been found that many owners will, if left to their own initiative, place their vessels in an unseaworthy condition by overloading. The draft thus marked represents not only the maximum, but also the most economical loading, for the vessel is carrying the maximum amount of weight and also sails better than if it were standing high in the water. It is therefore to the interest of the shipowner to find a cargo that will lower this vessel to its marks. In the case of the vessel of 7,000 dead-weight tons the total weight put on board should be 7,000 tons. All of this weight, however, is not cargo, for fuel, stores, dunnage, etc., are included. If all items other than cargo weigh 1,000 tons, the weight of the cargo should be 6,000 tons.

Explanation of Stowage Factor.—Therefore, the problem of the owner of this vessel is to find a general cargo that will weigh 6,000 tons and measure 340,000 cubic feet. This means that each ton must measure approximately 57 cubic feet. This figure, expressing the measurement of a long ton (2,240 pounds) of a commodity, is called the "stowage factor" of the commodity. Stowage factors vary from about 9 for pig lead to over 1,000 for unnested wicker baskets. Those commodities having a stowage factor less than 40 are termed "dead-weight cargo," and those with stowage factors of 40 or more are called "measurement freight." This distinction has arisen because the shipowner has found it desirable to charge by space if the commodity stows at more than 40 and by weight if it stows at less than 40. Many rates contain the provision that the charge will be made

STOWAGE FACTORS FOR SHIP CARGOES

Commodity	Type of packing	Gross weight (pounds)	Measurement, in cu. ft. and twelfths of cu. ft.	Stowage—Number of cu. ft. occupied by long ton	Remarks
Abrasives	Case	178	8-9	110	For optical use; carborundum stone and drilling diamond. See also Carborundum, Emery, Grindstones, etc.
Acetanilide	Barrel	238	8-11	83	
Acetone	Drum	845	24-3	70	110 gallons
Acid:					
Acetic	Barrel	475	12-0	60	
	Barrel	500	13-8	60	
Boracic	Barrel	350	10-0	70	
	Barrel	275	8-0	65	
Carbolic	Barrel	500	12-0	60	
	Case	237	8-0	65	
	Drum	1,100	24-3	54	
Carbolic crystals	Case	84	2-8	71	
	Drum	315	10-3	79	
Hydrochloric	Barrel	344	11-11	78	
	Carboy	190	6-0	80	
	Carboy	235	8-0	83	
Muriatic	.....	.....	.....	.....	See Acid, Hydrochloric
Nitric	Barrel	213	9-0	94	
	Carboy	190	8-0	94	
	Carboy	210	6-0	70	
Oxalic	Barrel	254	7-0	67	
	Barrel	375	10-3	67	
	Barrel	401	10-6	63	
	Barrel	374	10-6	67	
Phosphoric	Demijohn	120	6-0	112	5 gallons
Salicylic	Barrel	120	7-8	157	
	Barrel	120	7-3	150	
	Barrel	119	7-8	144	
Stearic	Bag	223	5-0	50	
	Bag	202	4-8	52	
Sulphuric	Carboy	229	8-0	59	
	Carboy	250	6-0	55	
	Drum	1,620	22-0	33	
	Drum	1,720	24-3	33	110 gallons
	Drum	900	11-7	31	55 gallons
Tartaric	Barrel	260	7-0	60	
	Barrel	250	7-2	64	Import
Advertising matter	Bale	106	3-0	63	
	Case	600	15-0	56	
	Case	224	8-0	80	
	Case	1,050	30-7	65	
	Case	72	2-0	62	
Aëroplane parts	Case	351	5-0	32	
	Case	280	3-0	24	
Aëroplane propeller and parts	Case	759	61-6	182	
Agar-agar	Bale	230	7-3	70	
	Bale	284	9-8	76	Import
Agricultural implements	Box	520	9-0	38	
	Box	685	11-5	37	
	Box	433	8-5	68	
	Box	402	5-6	31	
	Crate	236	9-11	94	
	Package	301	11-2	83	

NOTE.—Measurements are given in conformity with shipping practice, in cubic feet and twelfths of a cubic foot. Thus, "8-9" signifies eight and nine-twelfths cubic feet.

Stowage represents the number of cubic feet of cargo space in which a long ton (2,240 pounds) may be shipped. Thus, 110 cubic feet is the cargo space required for a ton of abrasives packed in cases averaging 178 pounds gross and measuring 8-9 cubic feet.

STOWAGE FACTORS FOR SHIP CARGOES—Continued

Commodity	Type of packing	Gross weight (pounds)	Measurement, in cu. ft. and twelfths of cu. ft.	Stowage—Number of cu. ft. occupied by long ton	Remarks
Agricultural machinery	.....	.....	.....	.....	See Machinery
Air compressor	.....	.....	.....	.....	See Machinery
Air-compressor pump	.....	.....	.....	.....	See Machinery
Alabastine	Case	112	2-0	36	
Albumen:					
Blood	Case	263	8-0	67	
Egg	Case	250	5-8	51	
	Case	249	6-4	57	Import
	Case	251	6-0	54	
	Case	244	5-11	54	Import. Tin container in a wooden case
Unspecified	Cask	.....	.....	60	
Alcohol:					
Grain	Barrel	336	11-8	78	
Methyl	Drum	848	23-4	62	
Wood	Barrel	400	10-0	61	
	Barrel	380	12-0	71	
	Drum	850	24-4	64	
Ale	Case	160	4-3	59	Bottled
	Case	180	4-9	60	Bottled
	Case	140	3-6	56	11 dozen pints
	Cask	.....	.....	54	Bulk
Alkali	Barrel	325	6-6	45	
	Drum	823	8-0	21	
Allspice	Bag	140	6-0	96	
Almonds	Bag	.....	.....	68	Shelled
	Bag	.....	.....	65	Shelled
	Bag	223	9-3	93	
	Bag	110	5-4	108	
Aloes	Case	131	1-11	32	
	Case	135	2-0	33	Two 5-gallon oil cans in wooden case covered with gunny cloth
	Case	127	2-0	35	Import
	Case	118	1-9	33	
Alum	Bag	220	8-9	89	
	Barrel	375	10-3	61	Lump
	Barrel	426	10-0	52	Powdered
	Barrel	425	10-3	54	Powdered
Alum earth	Cask	1,300	28-6	55	
Aluminium:					
Hydrate	Bag	275	5-0	40	
	Barrel	350	7-0	45	
Ingots	Box	130	2-4	40	
Ore	.....	.....	.....	.....	See Ore, Aluminium
Sulphate	Barrel	375	10-3	65	Lump
	Barrel	425	10-3	54	Powdered
	Barrel	426	10-0	52	Powdered
	Barrel	320	6-9	47	Powdered
	Barrel	425	10-0	52	Powdered
Ware	Box	227	9-3	91	
	Box	45	5-8	282	
	Box	251	26-8	256	Cooking utensils
	Box	120	10-3	191	
Amboyna wood	.....	.....	.....	50	
Ammonia:					
Anhydrous	Cylinder	268	5-0	41	
	Cylinder	287	5-0	42	Standard
	Cylinder	393	7-3	45	Large
	Cylinder	197	2-10	42	Small
Aqua	Drum	970	24-3	56	110 gallons
	Drum	943	23-4	55	
Dry	Barrel	611	18-0	65	

on the weight or measurement basis "at ship's option." The dividing line was established at 40 apparently because the older type of vessel would be filled without being lowered to its marks by freight that stowed at more than 40.

The Average Stowage Factor.—The vessel that we have been considering would pay best and sail easiest if it carried freight with a stowage factor of about 57. But vessels differ widely in their cargo-carrying capacity. Some are filled and lowered by cargo stowing at 40; others by cargo stowing at 90 or more. It is difficult to say what the average would be. Perhaps the ordinary cargo steamer should take freight stowing at from 52 to 55, and the average sailing vessel freight that stows at from 65 to 70. The sailing vessel has greater cubic capacity because of its construction and because no space is taken up by boilers and machinery.

Selecting Cargo by Lists of Stowage Factors.—The stowage factors of most commodities are known to the booking agent or he can easily find the factor of a given article by consulting some list of factors. Almost all steamship companies have their own lists, but the most complete and satisfactory one is that originally published by the War Trade Board. An extract from this is shown on pages 189 and 190 in order to illustrate the proper make-up of such a list. Knowing the stowage factors of different commodities and the capacity and dead-weight tonnage of his vessel, the agent can easily determine what sort of cargo will best suit his needs. But his problem is complicated by other considerations, unless he has the choice of bulk cargoes of different character. He may not have a choice at all, or he may have to accept commodities that vary greatly in their stowage factors. If he has no choice, he will in most cases, of course, take whatever is offered rather than allow the vessel to sail empty. If he is offered part cargoes of several different commodities, as would be the case if he were securing freight for a liner or for many tramps, he would try to accept a combination that would provide the necessary weight and volume. The problem of combining two commodities is relatively easy, and can be worked out by using the formula given on page 192.[2]

[2] Formula applies only in cases where the stowage factor of the lighter commodity is greater than the stowage factor of the vessel: that is, when b is greater than $\frac{V}{\quad}$

$$X = \frac{\left(\frac{V}{T} - a\right) T}{b - a}$$

in which

X = number of tons taken of the commodity having the higher stowage factor.
V = bale capacity in cubic feet.
T = total number of tons of cargo that can be carried = dead-weight tonnage of vessel less tonnage of fuel, stores, etc.
a = the lower of the two stowage factors.
b = the higher of the two stowage factors.

If we use again the illustration of the vessel with a bale capacity of 340,000 cubic feet and a dead-weight tonnage of 7,000, of which 6,000 tons can be made up of cargo, and if we assume that the agent is offered steel billets stowing at 10 cubic feet and cotton stowing at 90 cubic feet, the problem would be worked out as follows:

$$X = \frac{\left(\frac{340{,}000}{6{,}000} - 10\right) 6{,}000}{90 - 10} = \frac{(56.7 - 10)\ 6{,}000}{80}$$

= 3,500 tons, approximately number of tons of cotton that should be accepted.

The number of tons of steel would then be 6,000—3,500, or 2,500.

To prove that this cargo would provide the proper volume it is only necessary to multiply the number of tons of the two commodities by their respective stowage factors and add the results, as follows:

Volume of cotton	= 3,500 x 90 = 315,000 cubic feet
Volume of steel	= 2,500 x 10 = 25,000 cubic feet
Total volume of cargo	= 340,000 cubic feet

If there are a number of commodities instead of only two the problem becomes more difficult, and is worked out empirically. Assume that the "cargo list" of the freight accepted for the 7,000-ton vessel shows the articles in the table on the opposite page.

The booking clerk, upon reaching this point, knows that he should now secure 3,500 tons with a measurement of 90,000 cubic feet. The automobiles have taken up so much room that, to balance the cargo, dead-weight stowing at about 25 must be obtained if possible. He therefore tries to book rails, steel plates, or other heavy materials,

Articles	Weight in tons	Measurement in cubic feet
4,000 bales cotton	1,000	90,000
500 tons steel billets	500	5,000
1,000 cases patent leather	190	19,000
1,000 cases gloves	80	16,000
2,000 cases dried fruit	110	5,500
300 crates automobiles	620	115,000
	2,500	250,500

and he may offer a reduction in freight rates in order to get such freight. It is a common practice to quote "berth-cargo" rates on commodities that are usually available and can be used to round off a cargo satisfactorily, the berth-cargo rate being lower than the ordinary rate. In many cases, however, the agent can secure the desired freight at the full rate. There may be a large supply of steel in port waiting for transportation over the route taken by that vessel and the needed amount can be easily obtained. If light measurement cargo is wanted, it is possible that there will be a supply of tobacco, cotton, or other measurement freight from which to draw. In some cases the required class of freight is not to be had even at berth-cargo rates, and the vessel must sail with a poorly balanced cargo or must proceed to a near-by port where such freight is available. Liners, sailing on schedule, cannot be held to collect a well-balanced cargo, nor can they be sent to adjacent ports, so it is common for them to sail in a partially laden condition. The owner or charterer of a tramp, however, may find it advisable to send his ship to another port. This is a very common practice in some trades, as in the cork-carrying trade of Portugal and Spain. Cork has a very high stowage factor, so that a vessel laden with cork alone will ride high in the water and will be in an unseaworthy condition. Therefore, many vessels, before loading their cork, will sail to an adjacent port for a part cargo of iron ore or other dead-weight.

Lessened Importance of Obtaining Full Cargo.—The whole problem of securing an ideally balanced cargo is not so important as it formerly was, because the time factor is now of greater consideration and because the modern vessel is larger and can adjust its draft to some extent by filling or emptying its water tanks. The master of the old sailing vessel felt compelled to get a cargo that satisfied the

requirements of his ship. The loss of a few days in port did not mean much when compared with the loss of revenue or with the danger of the long voyage. Plenty of dead weight was required in order to make the vessel stable at sea; the hold had to be completely filled or the tossing of the small craft by the waves would cause a shifting of the cargo; and a full cargo was necessary to show profits for the long period of the voyage. The owner of a modern steamer, however, can increase profits best by decreasing his "turn-around." He depends more on speed and less on full cargoes than does the owner of the sailing vessel. He can make speed best by spending fewer days in port, and therefore he loads quickly the freight that is available, even though it does not give a well-balanced cargo. If it is too light, water can be taken into the tanks; if it is so heavy that it does not fill the space, some compartments can be left empty, or it can be secured against shifting easily as compared with the difficulty of securing the cargo of a sailing vessel.

But even now the matter of properly adjusting the accepted freight to the vessel demands a great deal of consideration. As already suggested, there are two problems. One is that of safely securing against shifting dead-weight cargo that does not fill the space allotted to it. The second problem, which is more serious, is that of compressing measurement freight into the smallest possible volume in order to get the maximum amount into the space.

Stowing Cargo with Low Stowage Factors.—There are a number of commodities that will lower a vessel to its marks before the space is filled, and some of these are very important commercial products. Iron ore is perhaps the best example of such a commodity. It is of such commercial importance and fits the ordinary vessel so poorly that special fleets of steamers have been designed to carry it. If heavy ore is put in the hold of a vessel designed to carry general cargo, the deep-load line will be reached before the space is filled, and it then becomes necessary to take precautions against the shifting of the ore. It was seen that the logical thing to do would be to contract the hold space, and this plan has been carried into effect. The style of steamer adopted by the Bethlehem Steel Company to bring iron ore from Chile has a double bottom raised 17 feet above the keel to contract the hold space and raise the center of gravity of the ore, and its hold breadth is only one-half the beam of the ves-

sel.[3] Such vessels can carry ore, coal, and other heavy bulk cargoes more economically and safely than can the ordinary steamer.

However, the movement of heavy freight is not confined to specially designed vessels. Much of it is carried by the common types of steamer in cargo lots or less than full cargo lots. If combined with other freight having a higher stowage factor, the cargo can be properly balanced in all probability; but if it makes up a large part, or all, of the cargo, special stowage measures must be adopted to insure safety. The mass cannot be permitted to lie loose in the hold, nor should all the weight be concentrated. The stevedore must "blow it up" to raise the center of gravity in order that the vessel will not roll excessively. The method of doing this for rails is described as follows by Hillcoat (p. 148):

Railway iron should be stowed fore-and-aft until level with the keelson, then diagonally, that is, grating fashion, keeping the rails well apart so that the weight will be raised to make the ship easy in a seaway.

Protect the ship's side with bars laid fore-and-aft on top of each other where the stowing is diagonal. Use rough sawn battens between the tiers when necessary.

Finish by stowing fore-and-aft, locking the two top tiers or so by inverting the upper rail; then lay 3-inch planks across the cargo under the beams and tomb them well down, placing the tombs about 5 feet apart; also wedge the upper tiers at the sides by driving large wedges down on planks put up and down before stowing for the purpose.

The 'tween-deck cargo is stowed fore-and-aft and is well tombed down like the lower hold.

The end tiers have also to be lashed with chain to keep them from fetching away when the ship is pitching heavily, a space being left about a third of the distance from the midship stanchions, between them and the side, for the purpose. Bars are laid across the top and the lashing passed around them and the 'tween-deck beam. With a laid 'tween-deck, rails will have to be laid across the first tier on the deck to lash down to. The lashings are wedged up tight and will require attending to at sea.

Reducing Stowage Factors.—Most of the articles that are carried by liner services, and even by tramps, on the more important

[3] Discussion of H. P. Frear on address of H. C. Sadler, "Bulk Freight Vessels of the Great Lakes," *Trans. Intern. Eng. Cong.*, Vol. X (1915), 123.

trade routes of the world have such high stowage factors that they fill the holds before bringing the vessel to their marks. The greater saving in shipping space, therefore, can be made by reducing the stowage factors, or by adopting stowage measures that will permit a greater number of packages to be stowed in a given space. In some instances saving can be made by changing the design of vessels.

Advantages of Reduction.—As previously stated, the average cargo steamer is completely filled and weighted by articles stowing at from about 52 to 55. It is not recommended that all articles be packed so that each ton will occupy 52 to 55 cubic feet, for this would be impossible of realization and would be uneconomical for those articles with a low stowage factor; but it would be desirable if the stowage factors of many commodities could be reduced to approximately this figure. This is a problem for the manufacturing exporter or other shipper of the goods. His backwardness in attacking the problem may be explained partly on the ground that he is unaware of its existence and partly by other packing complexities that demand his consideration. As far as known, the manufacturer has never yet been told what the stowage factor of his goods should be, and it is doubtful whether he even knows what "stowage factor" means. He has been given much advice concerning packing to avoid damage, packing to avoid excessive custom charges, allowable maximum weights and measurements, and other matters, but he has never been told that the average vessel will carry the maximum amount if its cargo occupies about 55 cubic feet to the ton. Perhaps he would not be interested in such a statement, for he would not see that it had any direct bearing on his freight charges. In most cases there would be no direct immediate effect, but a general reduction in freight rates. Ocean freight rates are fixed largely by competitive conditions. If the world tonnage could be handled by fewer vessels, there would be greater competition and rates would inevitably be lowered. The probable effect in one trade alone can be illustrated by considering the case of cotton.

The American standard bale of cotton stows at about 125 cubic feet. The average annual export of cotton for the period of 1914-1918 was about 7,000,000 bales, or 1,400,000 tons, since the average bale weighs 500 pounds. The total shipping space annually necessary to carry our cotton to foreign markets was, therefore, 195,000,000 cubic feet. This would require 551 steamers of 350,000 cubic

feet bale capacity and a dead weight of 7,500 tons. Assume now that our export bales could be compressed to the density of the bales from India and China, giving a stowage factor of 50. Only 70,000,000 cubic feet of space would then be required and this would be provided by 200 vessels of the size considered. If each steamer engaged was employed continuously in this service and made 8 round trips a year, 69 vessels would be required to carry the cotton as now baled and only 25 if the bales were packed according to Chinese custom. Forty-four vessels would thus be made available for other service, and if other service were not readily available, their owners would cut the freight rates on cotton in order to get a share of that business. The Shipping Board has recognized the great saving in space that could be made by better packing of cotton, and, for some time, refused to allow the operators of its vessels to accept the standard bale, thus forcing the shippers to put up high density bales having a stowage factor of about 85.

Reduction in War Period.—The shortage of shipping during the World War accomplished wonders in the general reduction of stowage factors. This was noticeable to those compiling the list of factors for the War Trade Board. More compact packing of a given commodity would decrease its stowage factor by 5 or more. Perhaps the most important work done along this line in the United States was that of the Packing Service Branch of the Army. In order to economize space in supply ships, radical changes in packing were adopted. Clothing, blankets, etc., were baled instead of cased, and this alone caused a saving of over $49,000,000 in freight rates during 1918.[4]

The space occupied by a 5-ton Packard truck was decreased from 1,000 cubic feet to 268 cubic feet, and similar reductions were made with other cased goods.

Reduction by Eliminating Broken Stowage.—It was easy for the Army authorities to specify the kind of packing acceptable, but the shipowner cannot do this. He must take the goods as they are delivered, unless the packing is unsafe, and he must stow them in the least possible space. He cannot repack the articles, but he can economize space by eliminating "broken stowage." The first step toward this end is taken by the booking clerk, who should secure some

[4] Capt. H. R. Moody, "Packing for Export." Official Proceedings of the Sixth National Foreign Trade Convention, 557–563.

small package freight to be used to fill in the broken stowage around the larger units. The next step is taken by the pier superintendent or stevedore in planning the stowage so that packages will fit snugly in the space allotted to them. And the final steps are taken by the foreman, whose duty it is to see that the packages are compactly stowed.

The work of the booking agent, although important, requires little further explanation. If he has booked a large number of bulky packages of different shapes and sizes, he should also secure, even at a reduction in rates, a number of small boxes, bags, and articles to fill the spaces left between the larger packages. In some cases the clerk does his work correctly, but it goes to naught because the smaller articles are not delivered to the hold in time to be of any use. This might be the fault of the shipper, the transportation medium, or the stevedore, who does not have transfer from the pier made at the proper time.

Planning the distribution of the cargo to economize space is difficult to describe because it varies with each cargo. One or two illustrations will best indicate the gain that can be made by careful planning. If the cargo consists of lumber and barrel oil, it would obviously be unwise to place the oil at the bottom of the hold. The beam there is contracted and the number of "longers" that could be placed would be limited. If the lumber is placed on the ceiling it conforms well to the shape of the lower hold and the great breadth of beam above is reserved for the barrels. This expedites the stowage of the barrels and reduces the broken stowage considerably. Another shipment may consist of a number of boxed automobiles, each measuring 6 feet by 6 feet by 10 feet, and the stevedore wishes to place the maximum number in a between space measuring 6 feet in height by 45 feet fore-and-aft by 64 feet beam. If he puts the boxes so that their lengths are fore-and-aft he can get in 6 rows of 7 boxes each, or a total of 42 boxes. If the lengths of the boxes are athwartship, there will be 10 rows with 4 boxes in each row, or a total of 40 boxes. By figuring this out on paper beforehand, the stevedore may avoid loss of time and loss of space.

The foreman and the individual longshoreman must exercise discretion in eliminating broken stowage between units of cargo. They must place the larger units compactly and fill in, if possible, any vacancies that unavoidably occur. Compact stowing requires the

use of both muscle and brain. Muscle is needed to force the units together. In stowing sacks of sugar, flour, etc., the longshoremen should throw the sacks forcefully into place, thus subjecting the contents to pressure and gaining a little space with each sack. On some classes of cargo pressure is applied mechanically. It was formerly the practice to spend a great deal of time in compression of cargoes of raw fibers, seeds, tobacco, and other products, but this is no longer done to any large extent except with cotton cargoes. In stowing cotton at most of the southern ports of the United States, hand screws are used to press the bales tightly together in order that a larger number of bales may be placed in the hold. "Screwing" of standard bales results in a saving of about 2 cubic feet to the bale, so that, for a large cargo of cotton, it is an economical operation in spite of the time consumed.

Skill is displayed in securing compact stowage of packages of irregular shape, and in properly arranging the stowage of two or more differently shaped packages in one space. In stowing car wheels, for example, the flanges of one pair must be set against the axles of the next, and the space above and below the axles should be filled with cases of the proper size and strength. An illustration of the thought and care necessary is afforded by the method of stowing completely assembled locomotives on the *Feltore*. Two thicknesses of oak planks (3″ by 12″ by 38′) were first laid on the "ceiling," and into these the wheel flanges were buried to their depth by the weight of the locomotives. Each locomotive was lowered by a 100-ton barge crane into the exact spot it was to occupy or as near thereto as possible. They were placed as close as their cow-catchers would allow, with the pilots toward the after bulkheads. In this way two athwartship rows of 5 locomotives each were placed. The space left against the forward bulkhead was partially filled with a locomotive placed athwartship. Wedges were put under the springs to distribute the weight and all brakes were set. Six blocks of wood of the proper shape were then placed on each boiler, and large timbers were laid on these, lengthwise of the engines. Baled hay was placed in all vacancies around the locomotives and five thicknesses of bales were placed on top of the timbers over the boilers. This provided a solid, secure floor upon which tenders were stowed, blocked, and dunnaged. There was still 10 feet of space left above the tier of tenders and this was filled with hay, oats, and motor trucks. The

whole cargo consisted of 33 complete locomotives and tenders, 2,400 tons of rails and splices, 2,300 tons of hay, 600 tons of oats, 53 motor trucks, and 1 thirty-foot steam launch.

Deck Loads.—With goods having exceptionally high stowage factors, the vessel cannot be lowered to its marks by below-deck cargo, even with the most careful stowage. Nonperishable goods can be stowed on deck, however, and this is a common practice with ship loads of lumber, cork, and other commodities. For the carriage of lumber, the most important commercial commodity of this class, especially designed vessels have been built, having a wide beam to compensate for the high center of gravity, a high freeboard and a great forward sheer to prevent wash of the deck cargo, and a bridge far aft to provide a long unobstructed deck space for the deck cargo.[5]

[5] Johnson and Huebner, *Principles of Ocean Transportation*, 44–46.

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CHAPTER XII

LAWS GOVERNING STOWAGE[1]

Necessity of Laws and Regulations.—The large number of cases of total or partial loss of ships and of cargoes of goods indicates that vessels are not properly constructed to withstand the dangers of ocean navigation or that they are not properly stowed or operated. The seriousness of these losses has long occupied the minds of those men who are primarily interested in the safe transportation of goods and passengers by water. Early in the history of maritime affairs it was seen that the individual shipowner, who looked for profits only and whose desire for large profits often overcame his better judgment, could not be depended upon to develop the safety and comfort of transport essential to the successful growth of a large and prosperous merchant marine, carrying passengers and freight to all parts of the world under all sorts of conditions. It was necessary to curb the spirit of daring that accompanies sea life, and to regulate the construction and operation of vessels in order that international commerce and intercourse might grow naturally and without interruption.

Gradually, therefore, a set of regulations has been developed to insure maximum safety at sea. These regulations are unsatisfactory in many ways. They are unnecessarily restrictive in some matters and too lenient in others, and they have been issued and enforced by so many different agencies and bodies that it is difficult for a man new to maritime affairs to understand them. Yet it is absolutely necessary that they be understood in order that they may be obeyed and that suggestions may be offered for their improvement. If our laws and regulations are to satisfy the men of the shipping world, these men not only must be thoroughly acquainted with the present laws but must be prepared to plan changes in their wording and in their administration. The time is not far distant when the United

[1] By Thomas R. Taylor.

States will be the leading maritime nation and its growth in equipment must be accompanied by an expansion and simplification of maritime law.

For purposes of discussion the present laws and regulations affecting the stowage of vessels may be grouped as follows:

I. Laws and regulations relative to the general seaworthiness of vessels.
   1. Governmental laws applicable to all vessels.
   2. Governmental laws applicable to passenger vessels.
   3. Rules of insurance underwriters.
   4. Rules of classification societies.

II. Laws and regulations relative to the stowage and carriage of certain classes of goods.
   1. Grain.
   2. Live stock.
   3. Dangerous goods.

Laws Relative to Seaworthiness of Vessels

Governmental Laws Applicable to All Vessels.—The laws of most nations make it a crime for a shipowner to send his vessel to sea unless it is fit to carry cargo and is in a seaworthy condition. The Harter Act, passed by the United States in 1893, is typical in its provisions. It provides that if the shipowner has not showed negligence, fault or failure in proper loading, stowage, custody, care, or proper delivery, and if he has used diligence in equipping, manning, provisioning, and outfitting the vessel, he shall not be responsible for loss or damage to goods due to *(a)* faults and errors in navigation and management; *(b)* dangers of the sea or other navigable water; *(c)* acts of God; *(d)* acts of public enemies; *(e)* inherent defects, quality or vice of the goods carried; *(f)* insufficiency of package containing the goods; *(g)* seizure under legal process; *(h)* act or omission of the shipper or owner of the goods; *(i)* the saving or attempt to save life or property at sea, and *(j)* deviation from course to save or to attempt to save life or property at sea.

In interpreting this law and similar laws of other nations, the

courts have decided that the shipowner is responsible for loss or damage occasioned in any of the following ways:

(a) Failure to put the vessel in a condition to *receive cargo* without damage to the cargo. The holds must be clean and fit in every way to contain goods without damage.

(b) Failure to fit the vessel in design, structure, condition, and equipment to encounter the ordinary perils of the voyage: The shipowner is responsible for defects in the ship or its equipment, but he is assisted in his efforts to disclose the defects. The vessel is built and outfitted under the supervision of trained inspectors of the classification societies, and certain regulations are laid down for the owner to follow in deciding what the condition and equipment should be. Thus, the laws of many maritime nations (not including the United States) specify the draft to which the vessel may be lowered, and the owner must be guided by the load lines marked on the sides of his ship. A vessel that is unfit may be detained at British ports, and the inspectors of the United States Steamboat Inspection Service may refuse permission to operate an unfit steam vessel.

The vessel must not only be fit to encounter ordinary sea perils but it must also be fit to carry safely to their destination goods of any particular kind that it guarantees to transport. If it undertakes to carry chilled meat it must be capable of keeping that meat at the proper temperature throughout the voyage.

(c) Failure to provide a competent master and a competent and sufficient crew.

(d) Failure to provide a pilot at a port where one may be secured and the nature of navigation requires one, unless the master himself has a competent knowledge of navigation.

(e) Loading a cargo which is not a safe one for such a voyage as might be reasonably expected.

(f) Failure to stow the cargo in such a way that it will be kept safe and intact until delivery.

It will be seen from the above that the owner of a freight vessel is limited in his control of that vessel. He must build it in a specified manner, he must provide competent officers and crew, he must make it fit to receive cargo, he must not load cargo that is unsafe, and he must stow the cargo safely. If he does not do these things he must suffer the consequences; and the chief fault to find with the

laws is the fact that it is "consequences" rather than prevention of movement that he must face. In other words, there is no representative of the United States who has the authority to examine a vessel before its sailing and to prohibit, if necessary, its departure. The owner of a freight vessel still has the power of sending his vessel to sea in an unseaworthy condition, and he will do so if the chances of reward seem greater than the chances of loss. The work of the supervising inspectors of the United States Steamboat Inspection Service should be enlarged to include the inspection of each vessel before it sails. Such inspection is now provided by the insurance underwriters, but their decisions are not mandatory.

Governmental Laws Applicable to Passenger Vessels.—Regulation of the equipment and operation of passenger vessels is more strict than the regulation of freight vessels because of the greater risk to human life in the case of passenger vessels. The Passenger Act of 1882 and other acts passed by the United States define the shipowner's responsibility and specify the conditions under which the vessel may proceed. Most of these specifications, however, do not deal with the question of stowage of cargo, and therefore cannot be considered here. As in the case of freight vessels, the laws of the United States are faulty in that they provide only for yearly inspection, rather than for inspection prior to sailing. A vessel carrying a thousand passengers may be so loaded that it is in imminent danger of catastrophe, yet it may sail unmolested. As with freight steamers, the supervising inspectors of the United States Steamboat Inspection Service of the Department of Commerce make the required annual inspection of hull, machinery and equipment, but they do not have the authority to inspect before each sailing.

Rules of Insurance Underwriters.—Owing to the necessity of protecting their own interests, men who underwrote insurance on hulls, cargo, and freight felt compelled to lay down certain rules and regulations to be followed by the shipowner. The first underwriters of marine insurance were those who gathered at Lloyd's coffee house in London in the eighteenth century, and out of this group arose an underwriters' association and a classification society, both of which are still internationally known as Lloyd's. The purpose of the underwriters' association was to facilitate the distribution of insurance risks among the members and to form a rate system the basis of which would be the risk factor. In determining the degree

of risk a primary consideration was the stowage of cargo, and therefore this and similar organizations have always played an important part in determining the method and place of stowing goods. In this country we have a number of such associations, well represented in New York by the Board of Underwriters of New York and the National Board of Marine Underwriters. In addition there are a large number of individual marine insurance companies with capital enough to carry alone the insurance on a ship or on several ships. The associations or companies have representatives in the different ports to act as inspectors of risks, and these men have the power to refuse insurance altogether or to fix the rate.

If the shipowner desires insurance on a cargo he applies to an underwriter, who, in order to fix the rate, looks up the record of the ship and its officers, and sends his representative to watch the loading process and to prescribe, if necessary, how the stowage shall be carried out. If the stevedore, the master, and the insurance representative work in harmony, there is no difficulty, but in many cases it is to the advantage of the stevedore and master to conceal matters from the inspector, and this places the inspector at a disadvantage, for it makes his inspection more difficult, and he cannot well refuse insurance unless he can prove before a court that the vessel is unseaworthy. His is the only check on the stowage of the vessel, and it is fortunate that the average intelligence and loyalty of the inspectors are so high that few faults escape their attention and condemnation.

In addition to providing this inspection system, the underwriters have in some instances issued instructions for the guidance of their representatives and of others. Most, if not all, of these instructions refer to dangerous cargo and will be mentioned more fully later.

Rules of Classification Societies.—The men who gathered at Lloyd's coffee house in London were responsible for the organization of the first classification society. As its name implies, the society was formed to classify vessels with respect to their seaworthiness. In order to give them an initial classification it was necessary to inspect the vessels during their construction, and changes in classification could be determined only by periodic inspection thereafter. Vessels that are assigned a high classification and are maintained there have low insurance rates, and it is, therefore, to the advantage of the shipowner to have his vessel in a class as high as possible. It is the

general practice to have classified all vessels, and the details of construction and equipment are therefore submitted to the representatives of the classification society in order that suggestions may be followed. The classification of all vessels and the essential information concerning them is published in large books that are familiar sights in any marine insurance office.

Lloyd's is still the most influential classification society and its annual Register of British and Foreign Shipping is the standard source of information on vessels. But there are similar societies in other maritime countries. The United States is represented by the rapidly growing Bureau of American and Foreign Shipping, which publishes the American Record of Shipping. Some of these societies are semi-governmental in nature and are delegated to enforce certain maritime laws. Thus, Lloyd's has been given the authority to regulate the marking of load lines on British vessels.

It will be seen, therefore, that these societies exert a powerful influence in determining the seaworthiness of vessels, and that their inspections have been of immense public benefit. It is largely because their work has proved so satisfactory that the need of inspection by government officials has been overlooked. And yet they are not entirely free of fault, for they must make concessions in order to get business, and it would seem, therefore, that some central public agency could perform the same service even more satisfactorily.

Laws Relative to the Stowage of Certain Classes of Goods

Laws and regulations for the stowage and carriage of certain classes of goods have been issued by so many different agencies that it is almost impossible for one man to be familiar with all the instructions. Port authorities, city departments, insurance underwriters and boards, surveyors of vessels, steamship companies, and various governmental bureaus and departments all have the authority to prescribe regulations pertaining to stowage of cargo, and the result is duplication, contradiction, and omission. Duplication and contradiction are to be noted most in the regulations relative to the stowage of dangerous goods. Port and city authorities, pier owners, and governmental bureaus give instructions as to the time, place, and method of loading dangerous goods; underwriters, steamship companies, and governmental bureaus prescribe the stowage. The

master of the vessel is therefore often at a loss as to whose instructions to follow, and especially so if he is proceeding to a country where even different regulations are in force. Because it is so easy to be confused, it is very desirable that we point out here the principal agencies that have published regulations on this subject.

Grain.—The stowage of grain has been subject to much regulation because of the relatively large number of casualties that have befallen members of the grain fleet of the world. Casualties are numerous because of the seasonal and dangerous character of the trade. Soon after the crop is gathered large numbers of tramp vessels gather at the exporting ports, at most of which the facilities are inadequate and the supervision is very incomplete. Many of these vessels are unfit to carry a commodity of this sort. Grain cargoes shift very easily and are damaged by water and vermin. Moreover, they are subject to spontaneous combustion, and many vessels have been totally destroyed by fire starting in the cargo of bulk grain.

The boards of insurance underwriters are the only agencies in this country that have issued instructions regarding the stowage of grain. The regulations of the Board of Underwriters of New York and of the Board of Underwriters of New Orleans apply to the Atlantic and Gulf coasts. The regulations of the Board of Underwriters of San Francisco have been superseded by the instructions of the San Francisco office of the United States Shipping Board. All of these regulations prescribe the erection of shifting boards to prevent shifting of the grain, the construction of feeders in the between-decks or hatchway to feed grain into the hold as the cargo there settles on the voyage, and other matters of similar character.

Perhaps the best known regulations are those of the Great Britain Board of Trade. Its "Memorandum Relating to Grain Cargoes" is procurable at Wyman & Sons, London, for one shilling, and its additional memoranda on the same subject may be followed in the columns of Lloyd's List, which is published daily in London.

Live Stock.—Regulation of the carriage of live stock from the United States is delegated to the Secretary of Agriculture, and the Bureau of Animal Industry, of the Department of Agriculture, issued in 1919 a little pamphlet on "Regulations Governing the Inspection, Humane Handling, and Safe Transport of Export Animals." This describes in detail the accommodations that must be provided for animals and the methods of handling them, and it

should be in the hands of every one who is interested in this phase of the stowage question. Other countries that are important in the export trade in live stock have also issued regulations, with which the master of a vessel engaged in that trade must become familiar.

Dangerous Goods.—One of the great dangers of ocean transport is from cargo that is capable of destroying the vessel, damaging other cargo, or endangering the health or lives of the crew. The kinds of goods that may do these things are indicated on page 221. In efforts to minimize the danger from such cargo various bodies have published information and instructions concerning them and their proper stowage.

The first set of regulations demanding consideration is that found in the laws of the United States. These laws may be divided into seven parts on the basis of their application. The first part consists of Section 8 of Passenger Act of 1882, which prohibits the carriage on *vessels carrying steerage passengers* of any nitroglycerin, dynamite, or any other explosive article or compound, or any vitriol (sulphuric acid) or like acids, or gunpowder, except for the ship's use, or any other articles which may endanger the health or lives of the passengers or the safety of the vessel.

The second part applies to *steam vessels carrying passengers* and consists of Sections 4422, 4424, 4472, and 4473 of the Revised Statutes. It prohibits the carriage on steamers carrying passengers of loose hay, loose cotton, loose hemp, camphene, nitroglycerin, naphtha, benzine, benzol, coal oil, crude or refined petroleum, or other like explosive burning fluid, or like dangerous articles. It also specifies that baled cotton or hemp shall be carried on such vessels only when packed as prescribed by the board of supervising inspectors; that gunpowder shall be carried only under special license; that acids must be carried on the decks or the guards thereof; that refined petroleum, which will not ignite at a temperature less than 110° F., may be carried under regulations on such steamers upon routes where there is no other practical mode of transporting it, and that turpentine and matches may be carried if packed in certain ways.

The third part of the law consists of Section 232 of the Act of March 4, 1909, and applies to *all common carriers carrying passengers*. It prohibits, except under certain conditions, the transportation of dynamite, gunpowder, or other explosives on such vessels.

The fourth part is made up of Section 4278, Revised Statutes,

and is applicable to *all vessels carrying passengers.* It prohibits the transportation on all such vessels of nitroglycerin, nitroleum, nitrated oil, or powder or fiber mixed or saturated with same.

The fifth part applies, with one or two exceptions, to *all steam vessels* carrying either passengers or freight. Section 4474, Revised Statutes, states the conditions under which oil may be used as fuel, and Sections 4475 and 4476 prescribe that gunpowder, nitroglycerin, camphene, naphtha, benzine, benzol, coal oil, crude or refined petroleum, acids, oil or spirits of turpentine, friction matches, and all other articles of like character shall be securely packed and put up separately from each other and from all other articles, and that the container of such an article must be distinctly marked on the outside with the name or description of the article therein.

The sixth part consists of Sections 234, 235, and 236 of the Act of March 4, 1909, and applies to *all common carriers.* It prohibits the transport of liquid nitroglycerin, fulminate in bulk in dry condition, or other like explosive; and prescribes that all packages containing explosives or like dangerous articles shall be plainly marked on the outside.

The seventh part applies to *all vessels* and is made up of Sections 4279 and 4288, Revised Statutes. It prescribes how nitroglycerin, nitroleum, and nitrated oil and powders, fibers mixed or saturated with same, must be packed and marked when put up for shipment, and that written notice must be given by the shipper to the ship's officer of the shipment of oil of vitriol, unslaked lime, inflammable matches, or gunpowder.

It will be readily apparent that the confusion of these laws must be reflected in their administration. The power of prohibiting the transportation of articles and of prescribing the mode of packing and stowing commodities is given to the Supervising Inspector General of the Steamboat Inspection Service. He and his supervising inspectors have performed admirable service in view of the faulty laws with which they have had to work. Whenever there is any question about the dangerous character of an article a sample is taken by the inspector and sent to Washington, where it is examined by the Bureau of Standards. This Bureau makes recommendations to the Supervising Inspector General, who thereupon publishes a ruling on the article. There are hundreds of such rulings that have been published in the circulars, the monthly bulletins, or the corre-

spondence of the Steamboat Inspection Service. Almost all of the rulings refer only to the transportation of dangerous articles by passenger steamers, and it is perhaps true that the jurisdiction of the Steamboat Inspection Service does not extend to the transportation of goods by freight vessels or sailing vessels carrying passengers. A number of articles are prohibited altogether from carriage by passenger steamers, and the methods of packing and stowing many others are outlined. These rulings are gathered together in "Stowage of Ship Cargoes," sold by the Superintendent of Documents, Washington, for 35 cents.

Just as the Steamboat Inspection Service is given authority in the matter of transportation of goods by vessel, the Interstate Commerce Commission is given authority over the transportation of goods by land vehicles. Its regulations are available to all in its publications, "Regulations for the Transportation of Explosives and Other Dangerous Articles by Freight and Express, and Specifications for Shipping Containers" (about 250 pages) and "Supplement No. 1" to same, procurable from the Superintendent of Documents, Washington, or from the Bureau of Explosives, New York City. This information is of great value to steamship officials because the methods of packing and marking prescribed for railway shipment are extended automatically to shipment by sea, and because the regulations have been applied to the coastwise lines. Division is made between explosives and other dangerous articles, and for each class and each article the methods of packing and marking are prescribed. There are also detailed specifications for the manufacture of containers for shipping various dangerous articles.

The coastwise lines are governed by the regulations of the Interstate Commerce Commission and of the Steamboat Inspection Service, and the manner in which they observe these rules is shown in the publications of the Bureau of Explosives, 30 Vesey Street, New York, especially in B. E. Pamphlet No. 5-B, "Regulations for the Transportation of Explosives and Dangerous Articles Other than Explosives" (1919). The pamphlet consists largely of a table which shows the way in which the different coastwise lines handle various dangerous articles. It gives about the same information that is found in the lists of dangerous cargoes that are privately kept by many steamship companies. Such a list should be maintained by every company. This is conveniently done by a card file, in which

are shown the names, dangerous characteristics and methods of stowage of the different commodities.

Another source of information which should be in the hands of every one interested in the loading of explosives is in the publications of the Treasury Department on anchorage grounds. The Secretary of War establishes anchorage grounds at different ports, especially anchorage grounds for the loading of explosives, and prescribes regulations relating thereto. These regulations are enforced by the Secretary of the Treasury through the Port Captains of the Coast Guard at New York, Philadelphia, Norfolk, and along the St. Mary's River; at other ports the regulations are enforced by the Chief of Engineers of the War Department. The rules laid down for the loading of explosives at New York, Philadelphia, or Norfolk may be had by applying to the Port Captain or to the U. S. Coast Guard, Washington.

The insurance underwriters have a great deal of information on dangerous cargo, only some of which is published. Boards of underwriters have lists of dangerous articles which are open to the inspection of members, but are not published, largely because they are subject to constant change. On the other hand, some of the boards have publicly issued advices on the loading and stowing of certain commodities. The Board of Underwriters of New York has printed instructions on the loading of calcium carbide, iron and coal, explosives, refined oils, and deck cargoes of coal. The National Board of Marine Underwriters has published a set of rules governing the loading of turpentine, rosin, cottonseed oil, and petroleum oil or its products in barrels from Gulf and Southern Atlantic ports. It is rather unfortunate that these boards are not more active in the distribution of information of this kind.

The Board of Trade in Great Britain has published a large amount of valuable information concerning dangerous cargoes, and its advice is more generally followed in the marine world than that of any other body. Its "Memorandum Relating to the Carriage of Dangerous Goods (Other than Explosives) in Ships" (1915) may be obtained from Wyman & Sons, London, for threepence.

The suggestion has been made that all of these regulations on dangerous articles should be coördinated and administered by some national or international body. It is doubtful whether an international tribunal is practical at present, but it would be a comparatively

simple matter to form a national clearing house of information and regulation by simply broadening the scope of the work of the Steamboat Inspection Service. It seems ridiculous that a steamer loading explosives is governed by regulations laid down by the Secretary of War and enforced by the Secretary of the Treasury, and that infractions of the regulations are punished by the Department of Commerce. Centralization of authority must be had, and this centralized authority must be given complete power. The old laws which permit the unrestricted shipment of alcohol and prohibit the shipment of camphene and petroleum on steamers carrying passengers should be repealed, and the Supervising Inspector General should be given the power of framing a complete set of regulations and of administering these regulations as he sees fit. Any law must be elastic to allow for the wide differences in ships, commodities, routes, etc., and an administrative body, such as the Steamboat Inspection Service, unhampered by old laws, could take these differences into consideration. This one body, with proper authority and increased personnel, could perform invaluable service in securing greater safety at sea and in relieving the American merchant marine of the needless restrictions now imposed upon it.

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CHAPTER XIII

STOWAGE FOR SECURITY[1]

Stowage must be carefully done if danger and damage are to be eliminated. Many vessels are lost by improper stowage [2] and thousands of dollars' worth of claims for damage to cargo are annually paid by steamship operators. This phase of the stowage question is of such human and financial interest that it has been rather extensively discussed and there are several good books on the subject (see references at end of chapter). It will only be necessary, therefore, to state the general principles involved.

Damage to Ship or Crew

Stowage will result in danger of loss of the vessel if *(a)* the center of gravity of the cargo is not put in the proper place, *(b)* the work is so carelessly done that the cargo will shift, and *(c)* proper safeguards are not thrown about dangerous cargo.

Improper Position of the Center of Gravity.—The proper point for the center of gravity varies with the vessel and the cargo. No general rule can be laid down; in each case the shipowner or master must follow his own knowledge and judgment. However, it is possible to point out some ways in which the master may go wrong.

If the center of gravity of the cargo is too high, the vessel will be liable to capsize. The beam and the freeboard help to determine the stability of the vessel, but the position of the center of gravity

[1] By Thomas R. Taylor.

[2] News dispatches to-day (January 19, 1920) state that the British steamer *Yarmouth* (725 tons) is sinking off the New Jersey coast, with the forward ballast tank leaking into the engine room. It left New York on January 17, with a heavy list to starboard, owing to the haste with which longshoremen loaded the cargo of $2,000,000 worth of liquors in an effort to get it out of the country before the law forbidding transportation of liquor went into effect. There is little doubt but that careless stowage was responsible for the loss.

is the most important factor. If the center of gravity is low there will be a strong force tending to return the ship to a vertical position after it has been inclined by wave action. If it is high, the force will be weaker; and if it is too high there will be no return movement and the vessel will roll over. Figure 84 shows stability curves for a vessel under three conditions of load. The length of the "righting arm" expresses the power of the ship to right itself. It will be noted

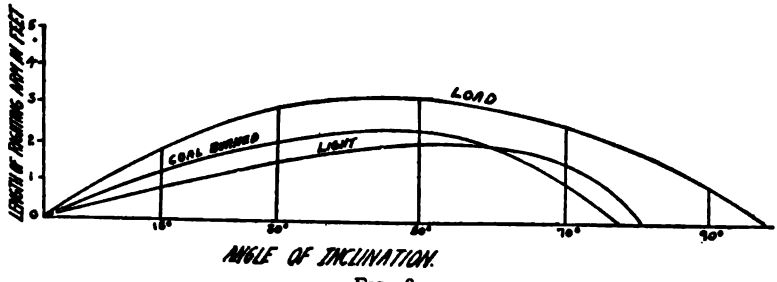

FIG. 84.

that this vessel will be stable at all angles to which it probably will be inclined. If, however, the vessel in its "coal burned" condition were thrown to an angle of about 75 degrees there would be no righting arm, and capsizing would immediately take place. Such curves are supplied to the shipowner by the architect or builder, and should be placed in the possession of the master. This officer should be able to interpret the curves and to construct new ones for each different load condition.

If the center of gravity is very low the righting force will be so great that the vessel will be brought up with a jerk, carried beyond the vertical position, and will then oscillate or "roll" until equilibrium is established. There is absolutely no danger of capsizing, but there is danger that the excessive rolling will cause seasickness of passengers and crew, chafing and shifting of cargo, strain of the vessel, and perhaps the breakage of parts and the tearing out of the masts. A ship in that condition is said to be "stiff," as contrasted to "crank," which is the term used to express an unstable condition. "Stiffness" is to be avoided on passenger steamers and sailing vessels especially. The great passenger liners are so constructed that it is almost impossible to make them "stiff," and with such vessels the master must use especial precaution to avoid raising the center of gravity to a danger point. The master of the smaller

vessel should place a part of the "dead-weight," or heavy, cargo high in the hold or in the between-decks in order to raise the center of gravity. In loading steel or iron, for example, about one-third of the total weight should be placed between decks.

Rolling may also be reduced somewhat by the movement of weight into the wings, but this method is in most cases more difficult of application than the first.

In the future, the master will probably have but little cause to worry over the matter of excessive rolling, because it seems quite probable that there will be a wide adoption of the "gyro-stabilizer," which keeps the vessel on an even keel.

If the center of gravity is to one side of the longitudinal axis of flotation, the vessel will be given a "list." Some vessels have a list when empty because of faulty construction; many more are given a list by loading more weight on one side of the keel than on the other. A small list is not dangerous, although it results in retardation or speed. In fact, some vessels, having more bunker space on one side, are started off with a list purposely, with the understanding that the stokers will use the coal out of the low side first and thus bring it to an even keel quickly. A heavy list, however, is very dangerous, for it sets up serious strains that may cause leakage, and it alters stability so greatly that the vessel may capsize at small angles of inclination. It is not difficult to avoid list at the start of the voyage. The cargo spaces on opposite sides of the keel are almost equal, and if goods having approximately the same stowage factor are loaded on each side there is little danger. Any list that does develop during loading is easily discovered and should be corrected at once. A list may develop at sea owing to use of fuel or stores, shifting of cargo or leakage. This is also easily detected, but is not so readily rectified. It may be necessary to send the crew into the hold to move the cargo or even to throw some of it overboard. Some step should be taken in each case where the list is over 4 degrees.

The longitudinal position of the center of gravity is also of great importance. If it is too far forward the bow will be submerged so deeply that it will not ride the waves easily, while the stern will perhaps be elevated to such a point that the propeller and rudder will not perform properly. At the bow and stern of each vessel there are marks to show the "draft" or the depth to which the hull is sunk in the water. "Trim" is the difference between the fore

and the aft drafts, and a vessel is said to be "in trim" when the two drafts are the same. A vessel sails most efficiently when it is in trim or when it has a slight "drag," that is, when the stern is a little lower than the bow. The raised quarter-deck vessel was designed to provide a greater cargo capacity aft than forward, in order that a "drag" might easily be obtained.

While in port the trim can be gauged by reading the drafts, and any necessary correction should be made at once to prevent damage by strain. On the voyage, trim may be altered by use of fuel and provisions, by shifting of cargo, or through some other cause, and it is sometimes difficult to tell what the alteration is. For this reason, vessels should be fitted with "pneumercators" or some other instrument that will permit the master to read the trim at any time.

The ship may be in trim and yet be liable to serious damage because of the improper longitudinal distribution of the load. If all the weight is placed at the two ends and none in the center, the vessel will "hog" or take a permanent shape in which its ends are lower than its midship section. If all the weight is concentrated amidships, "buckling" may result, and the vessel will become "sway-backed." Either result is to be avoided because of the undesirable effect on the sailing efficiency, strength, and beauty of the vessel. Yet it is not uncommon to see ships that have been "hogged" or "buckled." In many cases these results have followed from strains set up during the loading process. Because of the longitudinal division of the cargo space by bulkheads into holds, it is easy to acquire the erroneous idea that each hold is a unit in itself, and that the loading of one hold while others are empty can have no effect on the ship as a whole. Many vessels, especially those loading bulk dead-weight, are seriously strained and deformed by stowage of this kind. It must always be remembered that the weight must be uniformly distributed in the holds at all times.

One of the most puzzling problems is that of maintaining the center of gravity at the proper place when the vessel is loading and discharging cargo at several ports. It is almost impossible to distribute cargo for the different ports in such a way that all of it can be easily removed and that the vessel is not out of trim or instable on at least one of the "legs" of its voyage. The best judgment of the stevedore and master is required to plan a stowage that will approach the ideal. In some cases it will be necessary to rearrange the stowage

after discharge at one port. This, however, is a costly operation and should be followed only as a last resort. Figure 83, showing the stowage plan of a vessel discharging at three ports, illustrates some of the principles involved.

Shifting of Cargo.—Besides the damage caused to its constituent units, shifting of cargo may result in strain and breakage of parts and in a new and dangerous position of the center of gravity of the cargo. If the cargo moves downward, decks, stanchions, tank tops, and shell are in danger, and the new position of the weights may cause excessive rolling. If the cargo moves forward or aft, the bulkheads may be broken and the vessel will be put out of trim. If the cargo moves athwartship, the sides may be crushed and, in almost any event, a list will be developed. Perhaps the most common type of shifting on a large scale is transverse or athwartship shifting, caused by rolling of the vessel from side to side. The resultant list may be so "heavy" that the vessel becomes instable and may capsize.

Losses at sea due to shifting have been so excessive[8] that many especial precautionary measures have been adopted. This is best illustrated in the grain-carrying trade. No economical way of compressing grain into the hold is known. During the voyage the uncompressed grain settles, and a hold that was completely full at the loading port becomes partially empty. This empty space permits the grain to shift, and grain movements begin at a relatively low angle of inclination. To avoid danger from this source, two precautions are taken: In the first place, the holds are subdivided by the erection of "shifting boards" in order to confine the shift to a small amount of grain and to a small area. These "shifting boards" are of different construction and their number varies with the size of the hold. A common construction on small cargo steamers is a 2 or 3 inch plank partition placed fore-and-aft over the keelson, and braced with heavy timbers set against the beams in the wings. The second precaution taken is designed to keep the holds full of grain at all times. This is accomplished by stowing some of the bulk grain above the hold in such a way that it will feed into the hold as the grain there settles. In many cases special receptacles or "feeders,"

[8] The British Load-Line Committee reported in 1916 that definite causes of loss were discoverable in 57 of the 92 losses of vessels since the revision of the Tables of Freeboard, and that of the 57 losses, 12 were caused by shifting of cargo.

are constructed for this purpose, and these are placed either in the hatch or over the wings in the between decks, or in both places. The Board of Trade of Great Britain, the boards of insurance underwriters in the United States, and other bodies in other countries have issued regulations prescribing exactly how the shifting boards and feeders are to be constructed (see Chapter XII). If neither shifting boards nor feeders are used, a certain percentage of the grain must be bagged, according to these regulations.

Subdivision of the cargo space is necessary if fluids are to be carried safely. "For the transportation of petroleum and sometimes other oils in bulk, special 'tank steamers' have been constructed. The portions of the vessel used for the stowage of the oil are subdivided into small tanks by a strong longitudinal bulkhead extending the entire length of the ship above the center line of the vessel and rising to the uppermost deck, and by transverse bulkheads spaced about 24 feet apart. When these tanks are filled with oil the fore-and-aft and side-to-side movement of the oil caused by the pitching and rolling of the vessel at sea is reduced to a minimum." [4]

In some cases the principle of the shifting board is adapted to the stowage of other bulk cargo and of general cargo, but this is rare. General cargo, if stowed at all compactly, is not liable to shift seriously except in a few special cases. The breaking of barrels, due to pressure above, may permit the sudden movement of a large number of barrels with disastrous effect to the cargo and vessel. This is prevented only by careful stowage. If the barrels are tiered to a great height planks should be laid over one or more tiers to distribute the pressure brought by the tiers above. In several cases, general cargo has been known to break through a partition into a space that was left vacant for some reason. Such partitions must be strongly constructed.

Various measures are adopted to prevent shifting of dead-weight cargo that does not fill the space allotted to it. Railway iron, heavy logs, etc., are bound with chains, which are then fastened to parts of the vessel. Similar methods can be used for any cargo whose units are large. If the units are small, they can be covered by boards, tarpaulins or matting, and roped down. Large and heavy pieces can be "tombed" down or secured by shores set against the beams.

[4] Johnson and Huebner, *Principles of Ocean Transportation*. D. Appleton & Co., New York, 1918, 43, 44.

Dangerous Goods.—Almost any cargo is dangerous to some degree, but there are only a few commodities that are so destructive as to be ordinarily classed as "dangerous goods." The following classification is adopted from that given by Aeby, a Belgian chemist.

Classification of Dangerous Goods

I. Inflammable Goods:
   1. Spontaneously inflammable.
   2. Inflammable when heated, without the presence of flame.
   3. Inflammable in the presence of flame.
   4. Not ordinarily inflammable, but which under certain conditions may give off combustible or explosive gas.
   5. Producing inflammable dust.
   6. Generating heat when impregnating organic products.
   7. Taking fire by sparks.

II. Explosive Goods:
   1. Spontaneously explosive.
   2. Explosive by fire, friction, shocks, blows.
   3. Explosive when mixed with other bodies.
   4. Explosive by decomposition and discoloring.

III. Corrosive and Discoloring Goods:
   1. Corrosive solids (little danger unless moistened).
   2. Corrosive liquids.
   3. Producing corrosive or discoloring vapors.

IV. Evil Smelling and Asphyxiating Goods:
   1. Having a troublesome smell.
   2. Producing asphyxiating or anesthetic vapors.

V. Poisonous Goods:
   1. Poisonous solids and liquids.
   2. Producing poisonous gases.

VI. Miscellaneous Dangerous Goods:
   1. Tainting.
   2. Hydroscopic, or water attracting.
   3. Deliquescent, or giving off moisture.
   4. Having a low freezing or melting point.
   5. Acting to feed flames.
   6. Dusty.

Any of these classes of goods may cause damage to the vessel, endanger the health or life of members of the crew or passengers, or destroy other cargo. The inflammable and explosive goods are of the greatest danger to the vessel itself. Many marine losses are due to fire starting in the cargo. Special precaution must be used in handling goods that are spontaneously inflammable or explosive, and this class includes almost all animal and vegetable products in bulk, as well as many other organic compounds. Coal, grain, fibers, manures, lampblack, clothing, and varnishes are some of the more common commercial products liable to spontaneous combustion. The proper prevention is in most cases sufficient ventilation, for combustion is in almost all cases preceded by heating and the removal of the heat will probably keep the product at a temperature below the combustion point. The ship operator should become familiar with the available information on the subject.[5]

Although inflammable and explosive cargo is of the greatest danger to the vessel in causing total destruction, the other classes of dangerous cargo will damage the vessel in many cases. Corrosive goods have an especially deleterious effect on metal parts, and have been known to cause leakage. Evil smelling and asphyxiating goods leave odors in the hold which must be removed, sometimes at great expense, before other cargo can be loaded. Poisonous goods are of especial danger to the crew, and there are other goods, which, although not poisonous themselves, may produce a condition favorable to the growth and spread of germs of disease. The trim and stability of the vessel are affected by articles that gain or lose weight, by adding or losing water, on the voyage. Dust from coal, iron ore, and other products, discolors the timbers and destroys the beauty of the fittings in many cases.

Damage to Cargo

Damages to cargo may be caused by:

1. Dangerous goods of the classes described above.
2. Moisture.
3. Extremes of temperature.
4. Chafing and crushing.

[5] *See* Von Schwartz, *Fire and Explosion Risks. See also* Taylor, *Stowage of Ship Cargoes.*

5. Lack of ventilation.
6. Pilfering.
7. Vermin.
8. Wear and tear in transfer.

Dangerous Goods.—The kinds of goods that may cause injury to other goods are almost innumerable. Inflammable and explosive articles may destroy the entire cargo and the vessel, or may damage a part of the cargo by fire. Corrosive and discoloring goods, such as acids and chloride of lime, have serious effects on metals, colored cloths, and other commodities with which they are in close contact. Odors from fertilizers, vegetable and animal products, oils, barks, chemicals, scents, spices, soaps, and many other commodities will injure foodstuffs particularly; and the master must learn to stow malodorous goods apart from foodstuffs and in a dry and well-ventilated place. Foodstuffs and live cargo are also injured by poisonous goods, and these should not be accepted for transportation unless they are well packed. Dust damage is far more serious than is generally supposed. If it does not actually ruin the articles upon which it falls, it at least gives these an unsightly appearance which leads the consignee to file damage claims.

In the scope of this book it is impossible to make an adequate presentation of the way in which damage from dangerous goods may be avoided, for the method differs in almost every case. The master is guided to a large extent by the laws regulating the carriage of such commodities (see Chapter XII), and by his knowledge and experience. *Stowage of Ship Cargoes* should be consulted by any one handling a variety of cargoes, and each operator should maintain a list of dangerous goods, showing their characteristics and the best methods of stowing them.

Moisture.—Even a slight amount of moisture may cause discoloring, decay, rust, fermenting, chemical change, or odorization. It aids spontaneous combustion, and directly or indirectly damages almost every class of goods. Moreover, moisture damage is particularly difficult to avoid because water in various forms is found at almost every point of the voyage. Here again the action of the master and stevedore must be governed by common sense and sound judgment. Precautions must be taken first at the time of loading. The vessel's holds must be carefully prepared for the cargo. Leaks

should be repaired, the steam pipes must be looked over, rivet holes filled, decks cleaned, water passageways, scuppers, and limbers cleaned, and the pumps must be tried out and repaired if necessary. In almost all cases dunnage must be laid on the ceiling to protect the cargo from bilge water and leakage from the tank tops. If the goods to be stowed are especially susceptible of damage other precautions must be taken. Thus, a hold properly prepared for flour should have the beams and pillars muffled with canvas or matting to decrease the probability of condensation of moisture on these metal parts and the falling of the drops upon the cargo.

After the hold is made as dry and as water-tight as possible, loading may begin, unless the weather is stormy. Goods in bales and sacks, machinery, stationery, steel and iron, and other commodities that may be damaged by rain should not be transferred during wet weather. Some classes of goods should not be taken out of the transit shed if there is a heavy fog. These principles, of course, apply also to discharge.

All wet goods should be stowed underneath or apart from dry goods. Wet goods include liquids, some solids, such as butter that may become liquid, and any product that contains a relatively large amount of moisture. They should be stowed in holds to themselves or should be separated from the dry goods by dunnage.

After the cargo is stowed the hatches should be battened down tightly and covered with tarpaulin, unless ventilation is necessary. Good circulation of dry air through the cargo will help to prevent "sweating" and the accumulation of moisture. "Sweating" is caused by high temperature in the hold, and it may damage many kinds of commodities. During the voyage no water must be allowed to leak through the hatches or decks, and the bilge water must be removed by pumping. If possible, the cargo should be inspected to see that moisture is not entering and that any present is being removed by the pumps.

Extremes of Temperature.—There is very little danger from excessive cold on the voyage, for shipments that will carry safely by land are not liable to freeze at sea. Ocean temperatures and especially hold temperatures are relatively high, and for this reason many coastwise shipments are routed by water instead of railroad during the winter months. Occasionally very low temperatures are encountered at sea and damage may be done to alcohol solutions,

liquors, or other articles containing a high percentage of water. The only precaution that can be taken against such loss is to stow the goods in the warmest part of the hold, preferably near the boiler rooms.

The danger from high temperatures is much greater, because tropical voyages are more frequent than voyages in high latitudes and because the heat from the fires and from steaming cargo adds to the air temperature. High temperature may cause ullage of casks; melting of tallow, wax, and similar articles; spontaneous combustion; decay of many vegetable and animal products; chemical changes, and increased fire hazards, especially if the articles carried give off inflammable or explosive gases. Rum is almost the only commodity that is improved by heat, while there are many that are totally destroyed by excessive temperature. There are a number of precautions that may be adopted. The first is to refuse to accept for transportation anything which may be damaged by temperatures that can be reasonably expected, unless it can be carried in refrigerating space. The second precaution is to stow goods that may be damaged by heat in the coolest parts of the vessel—away from the boiler room, engines and steam pipes, near the bow, and in well-ventilated places, such as the between-decks and the hatchways. The third precaution is to provide ventilation throughout the cargo, and the fourth is to keep dry those goods that may decay, ferment, or heat spontaneously. Heat alone may not cause spontaneous heating of vegetable or animal products, but a combination of heat and moisture probably will. This spontaneous heating will damage the goods so heated and perhaps other products in the vicinity.

Chafing and Crushing.—Chafing and crushing, if excessive, will damage almost every commodity. Chafe injures fruits, cloths, glassware, machinery, and rope particularly. Crushing may result in the loss of liquids or of small articles from their containers, and will expose other commodities to the weather, moisture, dirt and theft. Both chafing and crushing are caused largely by movements of the cargo; therefore they cannot be eliminated altogether if rough weather is encountered, but they can be reduced to a minimum by careful stowage. The stowage must be compact. Units of cargo must be placed as closely as possible and any "broken stowage" should be filled with smaller units or with dunnage. If it is impossible to fill in all the interstices the units should be wedged, blocked,

or tombed so as to prevent their movement. In some cases it is advisable to nail or otherwise fasten together a number of units. In other cases, especially where there is a deep hold, there should be some divisions made between the different parts of the cargo, the divisions being complete enough to keep the cargo of one section from moving into any space left vacant in another section. This may be done by laying down a floor of boards. Movements on a large scale can also be prevented by constructing additional bulkheads or other partitions, as is done in the case of grain. The bedding of locomotives in bales of hay, described on page 199, is a good illustration of the methods employed.

A great deal of attention must be given to choosing the safest place for stowage of goods particularly susceptible to damage by crushing or chafing. The bow is to be avoided because the pitching is felt more there. The lower parts of the hold must also be avoided, for the great weight of the upper tiers will cause crushing. Fragile cases, barrels, etc., should not be stowed against the sharp edges of beams, stanchions, and other parts of the ship.

One of the most important precautions is to refuse to stow any goods that are not properly packed. Transportation should be refused altogether, or the fragile packages should be repaired at the pier.

Lack of Ventilation.—Lack of ventilation causes the accumulation of moisture and heat and the strengthening of odors as pointed out in previous paragraphs. A capable officer should be placed in charge of ventilation of cargo, fuel, and crew quarters during the voyage. Hatches should be kept open in clear weather if the cargo gives off obnoxious odors or is liable to spontaneous combustion. The ventilators should be so adjusted in height and direction that a good circulation of air is provided at all times.

Pilfering.—Upon delivery many consignments are discovered to be short, and the shipowner may have to pay the damage claim. The fact that he has pilferage insurance should not prevent him from doing everything possible to stop thievery. Pilfering begins at the pier and perhaps most of it occurs there; therefore, the first essential is a good watching system on the pier. It is not enough to station a kind old loafer at the entrance. There should be a check on each individual who enters the pier and upon his actions while he is there. Any one who has visited piers in this country knows how easy it is to

steal things if one has the desire. In many foreign countries the danger of pilferage is even greater because the people are poorer.

The longshoremen must be carefully watched by their foremen. It is easy to open a package that has been weakened by rough handling, or that was not securely packed in the first place, and to slip into a pocket a bar of soap, a piece of jewelry, a tool, or some other small and desirable article. The best preventive is to keep the men busy at all times and to impress on the foremen the necessity of being alert. In foreign countries, one of the ship's officers should be on watch.

Pilfering by the crew is relatively unimportant, but this also should be guarded against. Valuable goods should be stowed in a locker or strong room, the key to which is held by an officer. Liquors and other attractive products must be stowed in a place difficult of access. Frequent inspections should be made of the crew's quarters and of the cargo that can be reached.

Vermin.—There is always some damage from vermin during the course of the voyage. Conditions on shipboard favor vermin, because of the heat and moisture in the hold and the dirt that it is impossible to eradicate altogether. Even if the vessel is thoroughly cleaned and disinfected after the discharge of cargo, the new cargo may introduce another crop of vermin. The master therefore encounters several perplexing problems. He must, if possible, kill all vermin before cargo is loaded; he must not accept infested cargo or allow vermin to enter in any other way; and he must prevent the increase in number and the spread of vermin during the voyage. If, in spite of these precautions, there is an increase, he must endeavor to confine their ravages to a small part of the cargo.

The actual methods to be used on rats can be given to illustrate the principles involved. Rats are the most destructive vermin encountered in the shipping world. All ships should be disinfected with sulphur dioxide or cyanide gas, preferably the latter, periodically. Other rats should be denied access by fending the ship from the wharf by floating fenders, by placing rat funnels on all lines to the shore, by raising the gangplank at night, and by inspecting all cargo before it is placed on board. The ravages of any rats that remain or are admitted can be reduced somewhat by placing stores and valuable cargo in rat-proof compartments or by surrounding

them with cargo that is obnoxious to rats; by keeping a cat or rat terrier; by using poison or traps, and by providing the rats with food and water so that they will not attack the cargo. In destroying all sorts of vermin, the best measures are those that are preventive. Cleanliness is the first prerequisite. Careful inspections will disclose the appearance of vermin, and measures should be taken at once to stamp it out.

Wear and Tear in Transfer.—The damage that may be done to cargo by tearing of hooks, cutting and crushing of the sling, smashing of the carelessly handled draft, transfer in wet weather, rough treatment on the pier and in the hold, and by other causes have been sufficiently discussed in the chapters on transfer. The shipowner is, of course, liable to damage incurred in transfer and should exercise every precaution to avoid it. There is little excuse for damage of this sort at modern ports, but some is unavoidable at ports lacking proper harbor facilities.

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For additional references on stowage of dangerous goods see list at end of Chapter XII.

CHAPTER XIV

CLEARING THE WHARVES[1]

Movement of Merchandise on the Wharf

Merchandise on a wharf must be handled many times. The problem confronting the wharf superintendent is to reduce the number of handlings to a minimum and to make each handling as inexpensive and as rapid as possible. Some of these movements may be enumerated as follows:

In the first place, there is the movement to and from the picking-up point opposite the ship's hatch while transferring cargo into the ship or taking away cargo that has been discharged from the ship. Beginning with discharged cargo, the first movement is to the piles on the wharf in which the goods are sorted according to marks and consignees. If adequate wharf space is available, piling and tiering is reduced to a minimum. Each consignee's shipment should be piled in a separate pile, all packages together ready for further movement. If errors are made or if space is not available, and one consignment is piled on top of another, it is necessary later to break out these piles and move them about the wharf. This is all waste that should be eliminated through proper organization and proper wharf design. The principal movements that follow sorting are (1) the delivery of goods to railroad cars; (2) to dray; (3) to lighters, and (4) to a warehouse adjacent to the transit shed.

For short movement and odd jobs, within a small radius of travel, the hand truck will always be the most flexible and efficient tool. For longer distances, and for certain classes of goods, there are conveyors and tractors of various kinds. For distances of more than 150 or 200 feet other mechanical means are necessary, as both the hand truck and the conveyor, except in a few instances, become unprofitable. The advantages of the hand truck for short distances are the rapidity with which it can be loaded and unloaded and the

[1] By R. S. MacElwee.

small amount of space that is required for moving material by this means. It is the old relation of the terminal expense to the line haul reduced to small proportion. For short movements of a few feet, the "terminal expense" of more complicated instruments eats up any advantage of a more rapid movement horizontally.

FIG. 85.—HAND TRUCK.

Hand Trucks.—Freight is handled several times in loading and discharging it to and from the ship. One of the first instruments used is the hand truck. Usually three men are required to operate this truck, one to wheel it, and two to load it. Wheeling a hand truck seems a simple operation, but really it is quite a knack, acquired only after considerable practice.

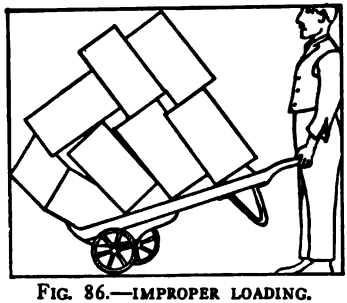


FIG. 86.—IMPROPER LOADING.

There are two positions in which a hand truck should repose when not in use: Standing on its wheels and legs with handles parallel to the floor, or standing on its wheels and nose with the handles in the air. The latter position is the most convenient, as the stevedore can grab it by the legs, wheel it to the load, tip it up on its nose, and his hands will be protected by the handles while it is being loaded. After it is loaded, he shifts his hands to the handles, pulls it toward him to a proper balance, and wheels it to the destination. It is not so simple without practice.

To load a hand truck with bags of sugar, coffee, etc., two men grab the bags, one at each end, and throw them on to the truck. The first bag must land on its side on the nose of the truck (Fig. 85), otherwise it will hang over, and the sharp edge of the nose will cut through the bag. All other bags must lie on their small side in order that a greater number may be placed on the truck.

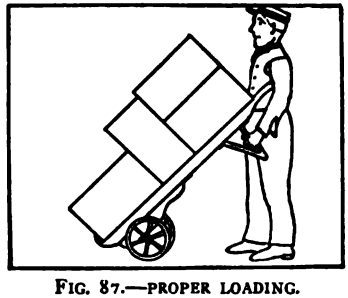


FIG. 87.—PROPER LOADING.

To load a barrel, tierce, or hogshead, tip it slightly, push the nose of the truck under the edges, reach over with the left hand, and pull it with the truck toward you to a proper balance, then wheel it away. If the load is heavy, another stevedore helps to push it over. Flour or other small barrels are loaded with one standing on its end, and another lying crosswise on top.

When loading boxes, the strongest and heaviest are put on the truck first with the frail ones on top. In all cases, except with bales of cotton and tierces of tobacco, care must be exercised when unloading. The truck must be allowed to come up slowly, permitting the load to strike the floor gently, after which the load is tipped slightly, and the truck removed. Cotton and tobacco may be rolled off the truck without damage.

Electric Trucks.—There are two schools of electric truck enthusiasts: Those who advocate a tractor and trailer system, and those who advocate a platform lift. The conclusion that may be drawn is that both systems are practical and applicable through different conditions. The platform-lift system has the advantage of greater flexibility and quicker starting and stopping, that is, a reduced terminal time, and this advantage is decidedly in favor of the platform-lift truck for short hauls. However, the tractors with trailer platform, although they require a little longer time to hook up and unhook at the end of the haul, cover a greater number of ton-miles per man. There is no reason why a terminal should not be equipped with both kinds, provided the platforms or the trailer trucks are constructed in such a manner that the platform-lift truck and the trailer truck can both operate. In delivery of small consignments to drays, the platform-lift truck has a distinct advantage, while in a longer haul with larger consignments of goods the tractor-trailer system has the advantage. Some figures concerning the saving of time and expense by using the electric trailer truck or other similar devices are shown in the following tables made by L. H. Haight. These stop-watch studies should be a guide to improvement in cutting time at various points along the line of operation.

Telphers.—There are two principal kinds of telphers: The monorail man trolley that travels hanging from an overhead rail, and the chain conveyors that are used in handling cotton in Mobile and Texas City, and elsewhere, or for handling frozen meats in London. The chain conveyor is adapted only to certain classified special-

ized packages, such as those mentioned, for which they are specially constructed. It is necessary to use the hand truck to bring the articles from the point of deposit on the wharf to the trolley.

The telpher that operates on an overhead track has been developed to greater flexibility by the introduction of a shop-crane crossover track or adjustable loop. The telpher will run along the tracks at the side of the shed until it comes to the point opposite the place where it desires to pick up or deposit merchandise, when the crossover or loop track will be run down to this point and by means of a switch the telpher or trolley will be able to cross over the bay on the loop. This makes it possible to cover every portion of the floor space. However, this equipment is expensive. It has been used to very great advantage in several sugar refineries and in the municipal cotton warehouses in New Orleans and also in those at Manchester. The cost of installation is great; it is not so flexible as it should be, but it has the advantage of traveling through unoccupied space, making high tiering possible, and thus saving floor space. Considerable development is still to be made in the transfer of cargo through unoccupied space, where the hand truck and electric storage battery truck are now in general use and deserve considerable attention.

Time Study of Movement at New York

These tables would show, first, what was actually being done by machinery now in use; second, they would show the many variations under which cargo is being handled; and, third, they might show how the work could be speeded up.

One point the tables bring out very clearly, and that is the unsteadiness of men in this work. The tables show that in very few instances are the same operations performed twice in exactly the same time. For instance, take the operation of loading 32 cases of condensed milk on an "airplane" platform. As noted in the table, the time varies from 1 minute 48 seconds, to 1 minute 56 seconds. It was plain that, in every instance, the time could just as well have been 1 minute flat, and if it were possible to use machines in this operation, the time would have been less, and each figure registered would have been the same.

The tables also show that, by employing fewer men and more machinery, cargo can be handled with greater speed and at less

ANALYSIS OF OPERATIONS AND TIME OF HANDLING CASED CONDENSED MILK FROM PIER TO SHIP BY "AIRPLANE" PLATFORM AT NEW YORK

No. Cases	Load on to Hand Trucks	Wheel Across Pier	Load on Airplane	Sling	Hoist and Lower to Hold	Unload	Stow	Return Airplane to Pier	Total
32	1M.15S.	2M.00S.	1M.50 S.	5 S.	1M.40 S.	1M.40 S.	2M.00 S.	1M.55 S.	11M.25 S.
32	1 .18	2 .04	1 .54	6	1 .42	1 .42	2 .04	1 .53	11 .43
32	1 .10	1 .58	1 .48	5	1 .40	1 .40	2 .02	1 .54	11 .17
32	1 .12	2 .00	1 .50	5	1 .45	1 .44	2 .00	1 .55	11 .31
32	1 .15	1 .56	1 .55	6	1 .40	1 .46	2 .06	1 .52	11 .36
32	1 .20	2 .02	1 .56	5	1 .42	1 .44	2 .04	1 .55	11 .48
32	1 .16	2 .00	1 .50	5	1 .40	1 .42	2 .00	1 .52	11 .25
32	1 .15	2 .04	1 .56	5	1 .41	1 .40	2 .02	1 .55	11 .38
32	1 .22	2 .02	1 .50	6	1 .40	1 .43	2 .03	1 .54	11 .40
32	1 .16	2 .00	1 .54	7	1 .41	1 .41	2 .06	1 .55	11 .43
32	1 .18	1 .58	1 .53	5	1 .40	1 .45	2 .02	1 .56	11 .37
32	1 .15	2 .02	1 .56	6	1 .43	1 .40	2 .01	1 .55	11 .38
32	1 .14	2 .00	1 .50	5	1 .40	1 .42	2 .06	1 .55	11 .32
32	1 .18	2 .04	1 .56	5	1 .42	1 .45	2 .04	1 .54	11 .48
32	1 .16	2 .00	1 .54	6	1 .40	1 .40	2 .00	1 .55	11 .31
32	1 .15	2 .06	1 .50	5	1 .41	1 .46	2 .02	1 .54	11 .39
32	1 .16	2 .04	1 .48	6	1 .40	1 .44	2 .00	1 .55	11 .33
32	1 .12	2 .00	1 .50	5	1 .42	1 .42	2 .04	1 .53	11 .28
32	1 .14	2 .06	1 .52	7	1 .43	1 .45	2 .02	1 .51	11 .40
32	1 .15	2 .04	1 .50	5	1 .40	1 .43	2 .00	1 .55	11 .34
640	25M.12S.	40M.30S.	37M.22S.	1M.50S.	33M.42 S.	34M.17 S.	40M.48 S.	38M.03 S.	272M.34 S.

NOTE.—Mr. Haight states the following:

In this case it was possible to record the operations 20 times, and it seems proper at this point to explain the method and difficulty under which these tables were obtained.

In the first place, it is impossible for one person to see every activity in connection with the loading and unloading of any one commodity. For instance, in handling the goods enumerated in the above table, there were four hand trucks wheeling cases to one "airplane," and, of course, it was possible to operate the stop-watch on only one truck at a time, so I timed one truck a certain number of times, another truck the same number of times and so on until all four trucks were timed. The same method was used in loading these trucks.

It will be noted that while the total "airplane" loading time is 37 minutes 22 seconds, the total wheeling time is 40 minutes 30 seconds and the total hand-truck loading time is only 25 minutes 12 seconds. This shows that there was some waiting, and that three, instead of four, hand trucks should have been used. The figure 2 M. under "Wheel across pier," represents the time for four trucks, while the actual time is 30 seconds. The total column is used to show the time of all activities, while the actual time of getting the goods into the ship, is shown under the column "Stow."

cost. Commissioner Hulbert says, "The steamship companies are satisfied with the present equipment, and do not desire more machinery installed."

By employing a tractor and four trailers, with an "airplane" on each trailer, we can back up to where the goods are stored, load all four "planes" in the same time that it would take to load one plane, and drive across the pier in less time than it would take with four hand trucks, which are now being used, and as the planes are already loaded, there will be no reloading at the ship's side. While the trailers are traveling across the pier, a stevedore can adjust the slings, making it necessary simply to "hook on" at the ship's side, thus, practically doing away with the time it now takes to sling the goods.

The plan condensed, is simply this. The ship will have two cranes to a hatch. There will be a tractor and eight trailers on the pier for this particular hatch. There will be 12 platforms, 4 in the hold, 4 on the trailers loaded, and 4 being loaded where the goods are stored.

The procedure will be as follows. On the pier: Load 4 platforms, wheel across pier, unhook tractor, return for another set of trailers that have been loaded in the meantime, wheel across pier,

ANALYSIS OF OPERATIONS AND TIME OF HANDLING RAILROAD RAILS FROM LIGHTER TO SHIP AT BUSH TERMINAL

No. Rails	Position to Sling	Waiting	Sling	Hoist Over Hatch	Lower in Hold	Unsling	Stow	Return Fall to Lighter	Total
1	1M.00 S.	0M.00 S.	1M.00 S.	35 S.	20 S.	15 S.	2M.00 S.	1M.00 S.	6M.10 S.
1	0 .50	5 .00	1 .00	37	21	18	1 .00	1 .10	11 .16
2	2 .00	0 .00	0 .50	40	18	20	5 .00	1 .00	10 .08
3	3 .00	15 .00	1 .30	40	19	25	10 .00	1 .00	31 .54
2	1 .00	20 .00	1 .00	35	20	16	2 .00	1 .00	26 .11
1	1 .30	0 .00	1 .21	38	20	15	2 .00	2 .00	8 .04
1	1 .10	4 .00	1 .00	35	22	15	2 .30	1 .05	10 .57
1	0 .56	0 .00	1 .15	36	20	18	1 .50	1 .10	6 .25
2	2 .15	6 .00	1 .00	35	22	15	2 .10	1 .00	13 .37
1	1 .04	0 .00	1 .00	38	20	19	2 .00	1 .08	6 .29
14	14M.45 S.	50M.00 S.	10M.56 S.	6M.09 S.	3M.22 S.	2M.36 S.	31M.30 S.	11M.33 S.	131M.11 S.

There were two lighters loading into four hatches. The above figures are for one hatch. The reason for only one to three rails in a draft—rails hit side of ship, and might slip out of sling. Waiting could not be accounted for.

ANALYSIS OF OPERATIONS AND TIME OF HANDLING RAILROAD RAILS FROM CAR TO LIGHTER AT HOBOKEN

No. Rails	Position to Sling	Waiting	Sling	Hoist Clear	Sling Over Lighter	Lower to Lighter	Unsling	Stow	Return Fall to Car	Total
3	2M.00 S.	0M.00S.	1M.00S.	15S.	8S.	12S.	15S.	2M.00S.	30S.	6M.20S.
4	2 .00	0 .00	1 .10	12	10	10	16	1 .10	32	6 .45
4	2 .30	0 .00	1 .20	18	15	15	18	2 .30	28	7 .54
3	2 .15	10 .00	1 .15	16	9	10	12	3 .00	32	17 .49
4	3 .00	0 .00	1 .30	20	15	12	14	4 .00	30	10 .01
4	2 .10	5 .00	1 .22	21	13	10	20	3 .50	27	13 .53
4	2 .20	0 .00	1 .12	16	10	14	14	2 .40	25	7 .31
3	2 .08	0 .00	1 .00	14	11	13	15	2 .10	29	6 .40
4	2 .41	0 .00	1 .25	17	12	15	16	2 .35	30	8 .01
4	2 .50	0 .00	1 .05	16	10	12	15	3 .00	30	8 .18
37	23M.54S.	15M.00S.	12M.19S.	2M.45S.	1M.53S.	2M.03S.	2M.25S.	28M.00S.	4M.53S.	93M.12S.

One crane unloading from car to lighter. Reason for not taking full draft of four rails each time—three rails were ready, and time would be lost waiting for the fourth rail.

ANALYSIS OF OPERATIONS AND TIME OF HANDLING CASE GOODS FROM LIGHTER TO SHIP "ADRIATIC" AT NEW YORK

No. Cases	Sling	Hook On	Hoist and Lower to Hold	Unsling	Stow	Return Burton to Lighter	Total
3	20 S.	10 S.	25 S.	21 S.	50 S.	30 S.	2M.36 S.
3	21	11	27	20	55	32	2 .46
3	19	12	26	22	58	33	2 .50
3	22	10	24	23	1M.06	35	3 .00
3	20	13	26	19	1 .10	30	2 .58
3	18	10	25	18	1 .14	30	2 .55
3	18	12	24	20	1 .18	35	3 .07
3	16	09	22	21	1 .22	33	3 .03
3	21	10	21	22	1 .23	32	3 .09
3	20	12	25	17	1 .26	30	3 .10
30	3M.15 S.	1M.49 S.	4M.05 S.	3M.23 S.	11M.42 S.	5M.20 S.	29M.34 S.

The dimensions of each case were 2′ x 2′ x 4′. There was one burton working, loading into one hold.

ANALYSIS OF OPERATIONS AND TIME OF REMOVING SAND BALLAST FROM SHIP "OSKAWA" TO LIGHTER AT NEW YORK

No. Buckets	Fill Bucket	Hoist to Lighter	Dump Bucket	Return Bucket to Hold	Total
1	1M.18 S	1M.30 S.	4 S.	1M.18 S.	4M.10 S.
1	1 .19	1 .32	5	1 .18	4 .14
1	1 .20	1 .31	4	1 .20	4 .15
1	1 .17	1 .33	3	1 .21	4 .14
1	1 .22	1 .30	6	1 .19	4 .17
1	1 .25	1 .33	5	1 .20	4 .23
1	1 .17	1 .30	5	1 .17	4 .09
1	1 .18	1 .35	6	1 .22	4 .21
1	1 .20	1 .32	5	1 .21	4 .18
1	1 .25	1 .30	5	1 .18	4 .18
10	13M.21 S.	15M.16 S.	48 S.	13M.14 S.	42M.39 S.

While there were four buckets in the hold being filled by six men, there was only one burton fall working, with one man trimming the sand in the lighter.

ANALYSIS OF OPERATIONS AND TIME OF HANDLING BARRELS OF OIL TO SHIP "ALEDO" FROM LIGHTER AT NEW YORK

No. Barrels	Prepare Barrels	Sling	Hook On	Hoist to Hold	Unsling	Stow	Return Burton to Lighter	Total
3	45 S.	25 S.	12S.	25 S.	22S.	1M.30S.	21 S.	4M.00S.
3	48	24	11	27	20	1 .29	22	4 .01
3	46	22	13	26	21	1 .32	23	4 .04
3	45	21	10	24	19	1 .30	22	3 .51
3	49	23	12	25	20	1 .35	21	4 .05
3	50	25	10	26	17	1 .34	23	4 .05
3	52	24	10	25	18	1 .31	22	4 .02
3	52	21	15	28	15	1 .36	24	4 .11
3	55	24	13	25	22	1 .35	24	4 .18
3	58	21	10	25	20	1 .30	21	4 .05
30	8M.20 S.	3M.50 S.	1M.56S.	4M.16 S.	3M.14S.	15M.22S.	3M.43S.	40M.42S.

There was only one burton fall working, loading into one hold.

ANALYSIS OF OPERATIONS AND TIME OF HANDLING BARREN ISLAND HORSE GREASE TO PIER FROM LIGHTER AT NEW YORK

No. Barrels	Prepare Barrels	Hook On	Hoist to Pier	Unhook to Pier	Test Barrels	Roll across Pier	Total
1	22S.	2S.	5S.	4S.	21S.	2M.00S.	2M.54S.
1	23	2	6	3	23	2 .04	3 .01
1	21	3	5	5	22	2 .08	3 .04
1	22	2	7	4	25	2 .06	3 .06
1	20	2	5	4	20	2 .04	2 .55
1	24	3	5	3	24	2 .06	3 .05
1	21	2	5	4	22	2 .05	2 .59
1	25	3	6	2	25	2 .00	3 .01
1	24	2	5	3	23	2 .10	3 .07
1	25	3	5	2	21	2 .12	3 .08
10	3M.47S.	24S.	54	34S.	3M.46S.	20M.55S.	30M.20S.

In this case, there was no room for the lighter to unload alongside of the ship, so the barrels were hoisted to and rolled across the pier, where they were immediately hoisted aboard a vessel.

ANALYSIS OF OPERATIONS AND TIME OF HANDLING GLYCERIN FROM PIER TO SHIP AT OLD DOMINION S. S. Co.'s PIER No. 26, NORTH RIVER

No. Tanks	Roll Across Pier to Ship's Deck	Sling	Hook On	Lower to Hold	Unsling	Roll across Hold Ceiling	Stow	Total
1	1M.30S.	5S.	3 S.	10S.	6S.	30S.	1M.45S.	4M.09S.
1	1 .40	5	4	8	5	32	1 .58	4 .32
1	1 .38	4	5	11	4	33	2 .00	4 .35
1	1 .39	6	4	9	4	30	1 .50	4 .22
1	1 .35	4	3	12	6	35	1 .48	4 .23
1	1 .34	8	6	10	5	31	2 .02	4 .36
1	1 .41	6	3	11	6	29	1 .59	4 .35
1	1 .30	8	4	10	5	30	1 .45	4 .12
1	1 .37	6	3	10	4	32	1 .58	4 .30
1	1 .40	5	3	10	5	30	2 .00	4 .33
10	16M.04S.	57S.	38S.	1M.41S.	50S.	5M.12S.	19M.05S.	44M.27S.

In this case, the tanks were rolled through the side of the ship to the main deck, were handled by one burton fall, which was part of the ship's gear, and lowered past the 'tween-deck to the hold.

ANALYSIS OF OPERATIONS AND TIME OF HANDLING CASE GOODS FROM PIER TO SHIP AT OLD DOMINION S. S. CO.'S PIER NO. 25, NORTH RIVER

No. Cases	Load on Hand Truck	Wheel across Pier to Ship's Deck	Unload	Put on Slide	Slide to 'Tween Deck	Slid across Deck	Stow	Total
1	18S.	1M.05S.	3S.	5S.	2S.	15S.	1M.00S.	2M.48S.
1	16	1 .08	4	4	2	18	1 .06	2 .58
1	18	1 .10	3	6	2	16	1 .04	2 .59
1	20	1 .04	5	4	2	20	1 .08	3 .03
1	17	1 .10	3	6	2	15	1 .10	3 .03
1	16	1 .04	3	4	2	16	1 .05	2 .50
1	15	1 .06	3	6	2	18	1 .12	3 .02
1	20	1 .10	4	5	2	17	1 .10	3 .08
1	15	1 .09	3	4	2	16	1 .11	3 .00
1	18	1 .06	4	5	2	18	1 .10	3 .03
10	2M.53S.	11M.12S.	35S.	49S.	20S.	2M.49S.	11M.16S.	29M.54S.

The dimensions of each case were 3′ x 3′ x 4′, weight 500 lbs each, and the "slide" passed through one side of the same hatch through which the glycerin was being lowered to the hold.

ANALYSIS OF OPERATIONS AND TIME OF HANDLING SACKS FROM PIER TO SHIP AT OLD DOMINION S. S. CO.'S PIER No. 26, NORTH RIVER

No. Sacks	Load on Hand Truck	Wheel across Pier	Wheel on Boat	Unload Truck	Sling Sacks	Lower in Hold	Unsling	Stow	Return Fall to Deck	Total
2	25S.	1M.18S.	30S.	5S.	25S.	1S.	5S.	1M.45S.	3S.	4M.37S.
2	28	1 .00	28	4	23	1	5	1 .50	3	4 .24
2	30	1 .16	28	4	22	1	4	1 .48	3	4 .36
2	25	1 .10	27	5	25	1	5	1 .54	3	4 .35
2	26	1 .06	30	4	24	1	4	1 .55	3	4 .33
2	30	1 .15	25	5	25	1	6	1 .50	4	4 .41
2	27	1 .20	25	4	24	1	4	1 .49	3	4 .37
2	25	1 .18	30	4	26	1	5	1 .45	3	4 .37
2	28	1 .18	29	5	25	2	4	1 .50	3	4 .40
2	25	1 .14	30	4	24	1	5	1 .49	3	4 .35
20	4M.29S.	12M.15S.	4M.42S.	44S.	4M.03S.	11S.	47S.	18M.15S.	31S.	45M.55S.

These sacks were supposed to contain oatmeal, weight 240 lbs. They were handled by a small deck crane, the boom running up about as high as a man can reach.

ANALYSIS OF OPERATIONS AND TIME OF HANDLING CASE GOODS FROM PIER TO SHIP AT OLD DOMINION S. S. CO.'S PIER No. 26, NORTH RIVER

No. Cases	Load on Hand Truck	Wheel across Pier	Wheel on Boat	Unload Truck	Sling Cases	Lower in Hold	Unsling	Stow	Return Fall to Deck	Total
4	50S.	2M.30S.	1M.00S.	12S.	40S.	3S.	5S.	1M.58S.	3S.	7M.21S.
4	48	2 .28	.58	14	38	3	4	1 .55	3	7 .11
4	45	2 .26	1 .02	10	36	3	4	1 .56	3	7 .05
4	46	2 .28	1 .00	10	38	3	6	1 .58	3	7 .12
4	48	2 .20	.58	12	40	3	4	1 .56	3	7 .04
4	46	2 .30	.58	11	38	3	5	1 .54	3	7 .08
4	50	2 .28	1 .00	10	40	3	4	1 .56	3	7 .14
4	48	2 .30	1 .06	12	36	3	4	1 .58	3	7 .20
4	46	2 .26	1 .02	10	38	3	5	1 .56	3	7 .09
4	46	2 .28	1 .00	10	36	3	4	1 .58	3	7 .08
40	7M.53S.	24M.34S.	10M.04S.	1M.51S.	6M.20S.	30	45S.	19M.25S.	30S.	71M.52S.

While the small deck crane handled mixed drafts of four cases each, there were two sets of hand trucks wheeling the goods, one set carrying three cases of tin-foil, and the other set carrying a large case. The hold was divided by a fore-and-aft bulkhead, with one hatch, and the cranes, placed just forward of the hatch, were able to operate from both sides at the same time.

ANALYSIS OF OPERATIONS AND TIME OF HANDLING AUTOMOBILES FROM PIER TO SHIP AT NEW YORK

No. Boxes	Roll across Pier	Sling	Hoist to Hold	Unsling	Roll across Hold	Stow	Total
1	2M.25S.	30S.	1M.55S.	15S.	1M.15S.	1M.55S.	8M.15S.
1	2 .20	35	1 .54	16	1 .12	1 .53	8 .18
1	2 .23	32	1 .56	14	1 .10	1 .54	8 .09
1	2 .26	30	1 .55	15	1 .10	1 .56	8 .12
1	2 .25	34	1 .56	16	1 .16	1 .54	8 .21
1	2 .28	30	1 .55	15	1 .13	1 .55	8 .16
1	2 .25	32	1 .54	18	1 .15	1 .58	8 .22
1	2 .30	30	1 .55	14	1 .10	1 .55	8 .14
1	2 .25	30	1 .53	15	1 .10	1 .54	8 .07
1	2 .28	33	1 .55	14	1 .15	1 .56	8 .21
10	24M.15S.	5M.16S.	19M.08S.	2M.32S.	12M.06S.	19M.10S.	82M.35S.

It will be noted in this table, as in all other tables, that it is impossible for men to repeat operations in exactly the same time.

ANALYSIS OF OPERATIONS AND TIME OF HANDLING QUARTERS OF BEEF FROM PIER TO SHIP AT NEW YORK

No. Quarters	Placing in Net Sling	Secure Sling	Hoist to Hold	Unsling	Carry across Hold	Stow	Total
10	20S.	18S.	1M.10S.	10S.	1M.30S.	1M 20S.	4M.48S.
10	25	20	1 .12	12	1 .33	1 .25	5 .07
10	28	15	1 .10	10	1 .30	1 .22	4 .55
10	24	18	1 .12	9	1 .35	1 .28	5 .06
10	22	19	1 .10	11	1 .30	1 .20	4 .52
10	20	16	1 .13	12	1 .32	1 .24	4 .57
10	26	18	1 .10	10	1 .34	1 .20	4 .58
10	20	15	1 .11	10	1 .36	1 .24	4 .56
10	25	18	1 .12	13	1 .38	1 .20	4 .06
10	22	20	1 .09	10	1 .31	1 .21	4 .53
100	3M.52S.	2M.57S.	11M.49S.	1M.47S.	15M.29S.	13M.44S.	48M.38S.

In this case, motor trucks backed up to the edge of the pier, men tossed the quarters into the net sling, and the beef was stowed into a refrigerator compartment.

ANALYSIS OF OPERATIONS AND TIME OF HANDLING EGGS FROM LIGHTER TO SHIP AT NEW YORK

No. Cases	Load on Airplane	Sling	Hoist and Lower to Hold	Unload	Stow	Return Airplane to Lighter	Total
16	1M.10S.	8S.	1M.50S.	1M.00S.	1M.50S.	1M.55S.	7M.53S.
16	1 .08	7	1 .48	1 .02	1 .52	1 .55	7 .52
16	1 .12	8	1 .50	1 .05	1 .48	1 .53	7 .56
16	1 .15	6	1 .51	1 .12	1 .52	1 .55	8 .11
16	1 .15	5	1 .50	1 .05	1 .50	1 .52	7 .57
16	1 .16	7	1 .49	1 .00	1 .54	1 .53	7 .59
16	1 .18	8	1 .50	1 .05	1 .51	1 .55	8 .07
16	1 .18	6	1 .49	1 .06	1 .55	1 .54	8 .08
16	1 .20	6	1 .50	1 .00	1 .50	1 .55	8 .01
16	1 .22	5	1 .48	1 .05	1 .49	1 .54	8 .03
160	12M.24S.	1M.06S.	18M.15S.	10M.40S.	18M.31S.	19M.01S.	80M.07S.

It will be noted by this table that it took longer to return the airplane to the lighter than to hoist and lower to hold. This is due to the fact that there was more or less waiting when returning the "airplane."

ANALYSIS OF OPERATIONS AND TIME OF HANDLING COFFEE FROM LIGHTER TO SHIP AT NEW YORK

No. Bags	Load on Web Sling	Sling	Hoist and Lower to Hold	Unload	Stow	Return Web Sling to Lighter	Total
12	42S.	5S.	1M.05S.	45S.	50S.	1M.42S.	5M.09S.
12	44	5	1 .06	48	48	1 .40	5 .11
12	41	6	1 .04	44	52	1 .45	5 .12
12	44	8	1 .05	46	50	1 .41	5 .14
12	43	7	1 .04	45	54	1 .42	5 .15
12	45	5	1 .05	42	52	1 .41	5 .10
12	45	6	1 .03	54	51	1 .40	5 .19
12	46	5	1 .05	55	50	1 .43	5 .24
12	48	6	1 .04	50	53	1 .42	5 .23
12	48	5	1 .05	48	49	1 .40	5 .15
120	7M.26S.	58S.	10M.46S.	7M.57S.	8M.29S.	16M.56S.	52M.32S.

COMPARATIVE COST OF HANDLING FREIGHT AS WITH HAND TRUCK OR TRACTOR AND TRAILER AT THE TERMINALS OF THE HUDSON NAVIGATION COMPANY

New York:						
1918.	July 2,	Cost	per	Ton	Hand truck	$ .59 9/10
1919.	July 2,	"	"	"	Tractor and trailer	.32 6/7
Albany:						
1918.	July 2,	"	"	"	Hand truck	.55 1/7
1919.	July 2,	"	"	"	Tractor and trailer	.39 1/2
Troy:						
1918.	July 2,	"	"	"	Hand truck	.49 3/5
1919.	July 2,	"	"	"	Tractor and trailer	.39 9/10
New York:						
1918.	July 9,	"	"	"	Hand truck	$ .56 1/5
1919.	July 9,	"	"	"	Tractor and trailer	.43 9/10
Albany:						
1918.	July 9,	"	"	"	Hand truck	.55 1/4
1919.	July 9,	"	"	"	Tractor and trailer	55. 1/4
Troy:						
1918.	July 9,	"	"	"	Hand truck	.59 5/7
1919.	July 9,	"	"	"	Tractor and trailer	.39 5/7
New York:						
1918.	July 16,	"	"	"	Hand truck	$ .62
1919.	July 16,	"	"	"	Tractor and trailer	.30 9/10
Albany:						
1918.	July 16,	"	"	"	Hand truck	.55 1/4
1919.	July 16,	"	"	"	Tractor and trailer	.38 5/9

Troy:			
1918. July 16, Cost per Ton	Hand truck		.59 5/7
1919. July 16, " " "	Tractor and trailer		.39 1/7
New York:			
1918. July 23, " " "	Hand truck		$ .63 1/5
1919. July 23, " " "	Tractor and trailer		.34 2/3
Albany:			
1918. July 23, " " "	Hand truck		.61 1/4
1919. July 23, " " "	Tractor and trailer		.37 1/9
Troy:			
1918. July 23, " " "	Hand truck		.61 3/4
1919. July 23, " " "	Tractor and trailer		.34
New York:			
1918. July 30, " " "	Hand truck		$ .60 3/5
1919. July 30, " " "	Tractor and trailer		.35 1/2
Albany:			
1918. July 30, " " "	Hand truck		.53 1/2
1919. July 30, " " "	Tractor and trailer		.38 1/2
Troy:			
1918. July 30, " " "	Hand truck		.63 3/10
1919. July 30, " " "	Tractor and trailer		.35 2/9
Average Cost per Ton:			
New York	Hand truck		$ .55 36/100
Albany	" "		.57 27/28
Troy	" "		.59 3/35
New York	Tractor and trailer		.36 4/35
Albany	" " "		.39 23/45
Troy	" " "		.35 55/63

COMPARATIVE COST OF HANDLING FREIGHT AS WITH HAND TRUCK OR TRACTOR AND TRAILER AT THE TERMINALS OF THE HUDSON NAVIGATION COMPANY—*Continued*

Average Number Tons, Hand Truck:				
New York	800.0	@	$ .55 36/100	$442.88
Albany	900.8	@	.57 27/28	522.15
Troy	600.1	@	.59 3/35	359.66
Total				$1,324.69
Average Number Tons, Tractor and Trailer:				
New York	800.0	@	$ .36 4/35	$288.92
Albany	900.8	@	.39 23/45	357.23
Troy	600.1	@	.35 55/63	215.28
Total				$861.43
Total average handling cost, hand truck				$1,324.69
Total average handling cost, tractor and trailer				861.43
Amount saved by tractor and trailer				$463.26
Amount saved per day, tractor and trailer				$92.65
Cost of equipping all ports, tractors and trailers, about				$18,000.00

Cost of new equipment saved in less than one season.

The above figures cover only five days in July, 1918 and 1919, and were compiled to show the difference in cost of handling freight by hand truck or tractor and trailer. In normal times the average cost of handling is 30 cents per ton.

hook on empty trailers, return for another load, and so on. On the ship: Hook on draft, hoist and lower to hold, stow, return platform to trailer, and so on. The return of the tractor with empty trailers has no business in the table, because it does not lose any time.

The time, using the figures in the table, will be as follows: Loading 4 platforms (128 cases), 1 minute 54 seconds. Wheel across pier—this time is cut in half as tractors travel faster than hand trucks—1 minute. Hook on—this time is reduced because the sling is adjusted while crossing the pier—8 seconds. Hoist and lower to hold (128 cases), 3 minutes 20 seconds. Unload, 3 minutes 20 seconds. Return platform to trailer, 3 minutes 50 seconds. If this is repeated 20 times, 2,560 cases will be handled in approximately 353 minutes and 54 seconds, as against 640 cases in 251 minutes and 43 seconds by hand trucks.

Sorting Coffee on Wharves at New Orleans

Efficient Methods of Handling Discharged Goods on Pier.—In other parts of this book the discussion is limited altogether to loading operations with the implication that discharge is not essentially different. However, there is one vital problem met in discharging that is not found in loading, namely, that of sorting and piling the discharged goods. The shipowner must not only put the goods on the lighter or pier, but he must separate the different consignments. How onerous a task this may become under some circumstances is shown in the following quotation from the report of the subcommittee appointed through the Chamber of Commerce of New Orleans to investigate the handling of coffee cargoes.[2]

The undersigned subcommittee, appointed to investigate the discharge of the cargo of coffee ex-S.S. *Manchurian Prince* is glad to report the results of their investigation, but before entering into the details, wish to express their appreciation for the kindness and valuable assistance rendered by Messrs. Warriner, agents of the abovementioned steamer, as well as by Superintendent Wren and officials of the Dock Board, who assisted in every possible way and gave all information requested.

[2] Manuscript loaned by the Chamber of Commerce, New Orleans.

As the object of this investigation is not to pass criticism on the present methods, but to make suggestions to improve actual conditions, we will abstain from making such comments and merely state facts and offer for the consideration of the committee suggestions, which, in the opinion of this subcommittee, may relieve the situation to a certain extent.

The steamship, *Manchurian Prince*, arrived on July 7 and was given a berth at the Poydras Street shed from section numbers 1 to 23 (the balance of this shed is being used by the Barge Line).

Discharge of the cargo of this steamer was somewhat hampered by the fact that part of the wharf was still being occupied by the coffee unloaded from the steamship *Maud M. Morey*, which, although she finished her discharge on June 27, when the *Manchurian Prince* arrived, on the morning of July 7, there were still on hand 14,620 sacks scattered in small piles in sections 11 to 23, on the river side, and 16 to 23 on the street side. Most of this coffee had been already weighed, but to the best of the information of this committee, through its changing hands from one owner to the other, delivery had not been taken from the wharf.

The stevedores of the *Manchurian Prince* were compelled to move the coffee of the *Maud M. Morey* at different times on July 7, 8, 9, 10, and 11. The expense in moving this coffee was for account of the said *Manchurian Prince.*

The *Maud M. Morey* arrived June 21, with 26,583 bags of coffee, and notwithstanding she completed her discharge on June 27, as stated above, on the morning of July 7, there were still on hand 14,620 bags, which prevented the *Manchurian Prince* beginning unloading from hold No. 5 until July 11.

The 14,620 bags were taken delivery of, as follows:

July 7, 1919	4,718 bags	
July 8, 1919	4,890 "	
July 9, 1919	1,981 "	
July 10, 1919	1,990 "	
July 11, 1919	1,041 "	14,620 bags

In order to obtain prompt relief at the wharf it was necessary for the Dock Board to use all persuasive means to induce the consignees of the cargo of the *Maud M. Morey* to take delivery of the balance of same.

This subcommittee has prepared the attached schedule No. 1, from which you will see in detail the work performed on the *Manchurian Prince*, and you will please note that the discharge of hatch No. 5 only began on the 11th, due, as stated above, to the coffee ex-S. S. *Maud M. Morey* occupying space at the shed which had been allocated to the *Manchurian Prince*.

This steamer should have completed her discharge on the afternoon of the 15th when hatch No. 2 was finished. This being on practically all ships the largest hold, the discharge should be so arranged that when the unloading of this hold is completed the balance of the cargo should be all out. Therefore, outside of the expense incurred in shifting the coffee from the *Maud M. Morey* from one place to another, there was an actual loss of time of one day to the *Manchurian Prince*, which loss Messrs. Warriner estimate to be about $4,000, and due to the above-mentioned conditions.

In the course of previous meetings it had been stated that one of the many reasons why there is a delay in taking delivery of the coffee immediately after the arrival of the ship, is the absence of shipping documents, but in the present case this feature does not enter into consideration, as entries were made at the customhouse, as follows:

On July 9.....	99,220 bags		
On July 10.....	9,800 "		
On July 14.....	2,000 "	111,020	bags

Owing to conditions at the port of loading, it is very difficult to separate the cargo in the holds of the ship in order to be able to know on arrival of the steamer in which hold each individual mark has been loaded. While these can be known on coffees loaded at Rio and Victoria, at Santos, where the largest percentage of coffee is loaded, it is sent alongside the ship in trucks and loaded indiscriminately, therefore making it impossible to effect a separation by marks in the holds.

Due to these circumstances, no plan is prepared as to how the cargo is to be stored in the shed, but as the coffee is being unloaded spaces are allocated for the different marks, with the result that at the time half of the cargo is out, there are different piles of the same mark in different sections of the shed, which hampers the delivery to the consignees and consequently the delay in clearing the coffee as it

is unloaded from the ship. Furthermore, a great deal of space is wasted in unnecessary gangways that, under the present method, have to be left unused in order to enable the men handling the coffee to get to the different piles.

During the course of the discharge there is always a certain percentage of bags which are landed torn or damaged and all these are stacked in one lot, which is called the "slack pile," and until the ship has completed discharge this coffee is separated by the different marks.

This hampers the discharge, as some of the consignees delay taking delivery of their lots until the said separation has been performed, especially lots going to the interior, where they naturally wish to send the complete number of bags as covered by the S. S. bill of lading; or if they take delivery, there are always left small piles which occupy large spaces. For instance, on the 11th of July bill of lading No. 7, from Victoria, consigned to Messrs. Hard & Rand, covering 250 bags marked H.R. 34, and 230 bags marked H.R. 80, of this latter lot only 235 were delivered on that date, leaving 15 bags pending which, to all intents and purposes, are in the slack pile.

It has been customary for the different coffee importers to assort their lots by the different numbers of each mark covered by one bill of lading. This assortment not only requires a much larger area to effect this handling, but unnecessarily delays the clearing of the coffee. The coffee is usually piled on the wharf from 12 to 15 bags high, and at the time this reassortment and reweighing is performed the weighers, for the convenience of their work, only stack the coffee six bags high, which, you will readily appreciate, at least duplicates the space used in the handling of the coffee.

Furthermore, the importers do not take delivery of the coffee as promptly as it is discharged, as several sales of the same lot of coffee are carried out during the time the coffee is being unloaded on the wharf. These sales are not always made of the total number of bags covered by the steamship bill of lading, but this amount is divided into one, two, or three lots, which necessitates extra handling in each instance, thus further delaying the delivery from the wharf, which becomes practically a private warehouse, thus increasing the area required for the storage of the coffee.

The following will confirm the above statement:

Bill of lading No. 5, from Rio, covered 1,000 bags marked J.A.A. 1/14, consigned to J. Aron & Company, who sold them to Messrs. Seago & Company, who in turn sold them to Messrs. Levy & Company. In order that Messrs. Levy & Company could take delivery, Messrs. Seago & Company requested the following separations:

1—20	8—112
2—23	9— 75
3—20	10—248
4—43	11— 42
5—64	12— 40
6—57	13— 33
7—59	14—153

Bill of lading No. 6, from Rio, covered 1,000 bags marked J.B.A. 15/28, consigned to J. Aron & Company, who sold to Messrs. Seago & Company 750 bags and 250 bags to be shipped to the interior, therefore, making it necessary to separate by the different numbers.

Bill of lading No. 65, from Santos, covered 2,500 bags marked G. C/A. 1/19, consigned to Messrs. G. Amsinck & Company. The said firm, instead of taking delivery of the whole lot as called for by the bill of lading, requested on July 16 that they be allowed to take delivery of only 1,000 bags, made up as follows:

1—32	8— 13
2—71	9—277
3—35	10— 50
4—18	17— 25
5—80	18—100

19—299

Messrs. Warriner declined to allow this assortment and the matter was taken up with the Dock Board, who authorized on July 18 that the said lot should all be taken delivery of at once, divided in the following three lots:

To Messrs.	G. Amsinck & Co.	500	bags
" "	Ruffner, McDowell & Burch	1,000	"
" "	G. Amsinck & Co.	1,000	"

as follows:

Amsinck & Co.	Ruffner McDowell & Burch	Amsinck to Warehouse
1–21	53	32
2–47	218	71
3–23	58	35
4–12	24	18
5–40	..	80
6–24	96	..
7–31	122	..
8– 4	..	13
9–70	..	277
10–43	84	50
11–42	151	..
12–10	41	..
13–12	57	..
14–10	42	..
15–10	40	..
16– 4	14	..
17– 6	..	25
18–25	..	100
19–75	..	299
500	1,000	1,000

Bill of lading No. 15, from Rio, covered 500 bags marked H.R. 1/3, consigned to Messrs. Hard & Rand. This firm wrote on the 7th of July to Mr. G. A. Peyrefitte, as follows:

Please weigh ex-dock *S. S. Manchurian Prince* coffee to the following. Submark each lot as shown below. Charge all to our account.

Henry Lochte Co. Ltd.
H.R. 20) — 25 Saturday
J.R. 3) — 25
50

Submark: H. L. C.

L. C. Fallon & Co.
H.R.) 1 — 54 Saturday
J.R.) 2 — 27
3 — 169
250

Submark: L. C. F.

Albert Mackie Co., Ltd.,
H.R.) 1 — 25
J.R.) 2 — 25
3 — 125 Monday
175

Submark: A. M. C.

A. Wahking & Sons.
H.R.) 3 — 25 Saturday
J.R.)

Submark: A. W. S.

Bill of lading No. 10, from Rio, covered 1,000 bags marked S. C./C. 34/58, consigned to Messrs. Stewart Carnel Company, Ltd., had to be separated as follows:

34—78	47—92
35—72	48—42
36—90	49—75
37—29	50—30
38—20	51—58
39—25	52—33
40—19	53—34
41—27	54—13
42—61	55—27
43—11	56—11
44—67	57—23
45—12	58— 6
46—45	

To effect the above or similar separations at the wharf at the time of discharge, considerably increases the necessary area to store the coffee, and if no separation is made at the time of discharge it delays the deliveries until there is sufficient space to perform the work.

Bill of lading No. 15, from Victoria, covered 2,000 bags marked V & L/Brazil 13/16, consigned to J. Aron & Company. Of No. 13 there were 650, and of these 500 were sold to Messrs. K. Seago & Company, thus leaving for account of Aron & Company 1,500 bags.

Bill of lading No. 15, from Victoria, covering 2,000 bags. Out of these there were 366 of chop No. 3. Messrs. Aron & Company, as per their order 2010, registered 4656, sold three bags to Messrs. L. C. Fallon & Company, who in turn disposed of them to Nicholas Burke & Company, and were sold by this firm to Bloom's Sons Company, who finally sold them again to Messrs. T. J. Henderson, and this firm took delivery of same on the 18th of July.

Bill of lading No. 5, from Victoria, covered 500 bags; 250 bags marked HR 35 and 250 marked HR 77, consigned to Messrs. M. Levy & Son, who sold them to Messrs. Bloom's Sons Company, who again sold them to Messrs. J. Aron & Company, and finally taken delivery of by L. C. Fallon & Company.

Several other cases under the same conditions as above could be cited, but this subcommittee feels that those already quoted will be sufficient to enlighten you as to the practice at present followed. This practice is not permitted at New York, where the coffee must be taken delivery of immediately after discharge, although item for

item the cost of handling at the said port is greater than the cost of this port.

You will find attached herewith statement No. 2, showing in detail the number of bags daily hauled by each consignee, and your particular attention is called to the fact that on the 31st of July, or 15 days after the steamer had completed discharge, there were still on hand 774 bags.

The delay in taking delivery of the coffee not only works a hardship on the Dock Board by occupying space which is so badly needed for other coffee cargoes, but represents an expense to the agent of the line, as, according to the customs of the port, they are responsible to the consignees for the coffee until delivered, and consequently have to employ a sufficient number of watchmen to take care of the coffee.

By glancing over statement No. 2, you will please note that the firm of Israel Brothers took prompt delivery of their lots; this being due to the fact that this firm assorted their different lots and weighed them at a private warehouse.

We unhesitatingly recommend that every influence be brought upon the Dock Board to build two-story warehouses, the lower floor to be used for the receiving of the import coffee and the upper floor for the assortment and reweighing, for which operation a charge could be made to the importer, which will not result in an additional burden, as, we repeat, the charges through New Orleans are much lower than through other ports.[3]

As previously mentioned, no plan is prepared by the steamship agents on arrival of the coffee cargoes as to how these are to be stowed in the shed, but the subcommittee has prepared for the consideration of all interested parties the attached tentative plan, from which you will note that in the available space 111,020 bags manifested per the *Manchurian Prince* were distributed, leaving necessary space for the different gangways of three feet in width, from which you will please note that the whole cargo could have been stored in Poydras Shed, even assuming that no coffee was taken delivery of until after completion of the discharge.

[3] The two-story shed recommended here is an attempt to supply supporting warehouse or storage space (*see* Bulletin, American Association of Port Authorities, Dec., 1920, article by R. S. MacElwee). The three-story Cressen, Jr., type, such as at the Army Supply Base, Philadelphia, would fill this need. It is the writer's opinion that this sorting, weighing, reselling, and other merchandising processes should be carried on in warehouses across the marginal street from the transit shed, reached by bridge and trailer trucks or conveyors.

However, as per statement No. 2, the committee will note that the unloading having commenced on the 7th, deliveries were made on the 9th; therefore, the space is sufficient to take care of one of the average monthly cargoes coming to this port, as outside of the *Glenative* and the *Chinese Prince*, which had 114,000 and 115,000 bags, respectively, all the other cargoes were around 100,000 and the majority under 100,000 bags.

As an explanation of this plan we took as a basis lots of 250 bags, 500 bags, and 1,000 bags, as in the majority of cases these are the numbers covered by each bill of lading.

The wharf was divided into four sections, Section A, on which the piles can be built up to 15 bags high, and Sections B, C, and D, on which piles can be built only up to 12 bags high.

While the piles can be stored higher, owing to the lack of machinery and in order to facilitate the separation of the different lots as per bill of lading in the attached plan, the lots are piled only up to 12 and 15 bags high.

In Section A, on which you will see only lots of 100 bags are stacked, the piles have been made of 10 bags in length and 7 in width, occupying 30 by 14 feet, or 420 square feet, which gives room enough for 1,005 bags.

On the lot 12 bags high the following sized piles have been planned:

Of	250 bags:	Square occupying 18 x 12 feet, or 216 square feet, with sufficient room to store 288 bags.
Of	500 bags:	Square occupying 21 x 12 feet, or 252 square feet, with sufficient room to store 504 bags.
Of	1,000 bags:	Square occupying 36 x 14 feet, or 504 square feet, with sufficient room to store 1,004 bags.

We would suggest that on arrival of each steamer the Dock Board be furnished with a copy of the manifest, when a similar plan can be prepared showing the space in which each individual lot is to be unloaded. While this may require a larger number of men properly to stack the coffee in its specific lots, as it may be that the spaces allocated to one mark are on the opposite side of the ship to the hold in which it has been loaded, yet the number of men used in effecting this separation would compensate the interested parties for the time saved to the ship and help in clearing the coffee from the wharf.

By following the above method the coffee that is daily landed from the ship in a damaged condition and at present stacked in the slack pile could be daily reconditioned and redistributed to its specific lots, thereby enabling the consignee to take delivery of complete lots.

By following the above plan it would not be possible to separate the different lots as they are landed by chop numbers, but this subcommittee would suggest that on arrival of the steamer each consignee should deliver to the Dock Board his request as to how he desires his lots to be subdivided, and as space is being vacated by deliveries made, each consignee could be allowed to shift the coffee from the original piles to the space so vacated and use same for reweighing and separating the marks by the different chop numbers.

In order to avoid confusion at the wharf, a consignee should not be allowed to reweigh or separate more than one lot at a time; that is to say, until one lot as per bill of lading has been cleared out of the wharf, the consignees could not commence to separate or reweigh the next lot.

This subcommittee has also prepared an index by marks, which is attached herewith and which completes the plan of distribution, so that each consignee could know where his coffee was going to be stored and therefore be able to ascertain when the complete lot as per bill of lading had been unloaded and therefore proceed to take delivery without delay. It is evident that if all three interested parties, the Dock Board, the steamship agent, and the coffee importer, would coöperate, especially the latter by hauling his coffee as soon as the piles are completed, the present difficult situation could be greatly relieved.

This subcommittee begs leave to submit the above report, inspired in their sincere desire to assist, although in a very modest way, in the improvement of conditions which in a way may hamper the development of the port which we all have at heart. (*Sgd.* HEGOWISCH.)

Fortunately these conditions are not representative of all discharging operations. In comparison, the steps ordinarily necessary to deliver the different consignments seem comparatively simple. There are, however, in almost all cases, some difficulties to be overcome. There is lack of room on many one-story piers and the goods have to be piled "on the farm," that is, on the pavement or street at the end of the pier; there are the problems of piling; and there must always be a slack pile for damaged goods to be recoopered, resewn, renailed or adjusted. The best methods of carrying the freight from

the point of discharge to the storage space have been indicated in the preceding section; there remain the questions of separation and stacking.

Separation is accomplished in part in the hold and in part on the pier. If it can be done without undue delay, drafts should be made up of goods of one consignment only. Since the different consignments are generally easily distinguishable by mark or character, and since many consignments are of one character throughout, separation in the hold is not as difficult as one might imagine. The one-consignment draft can be lowered to a truck and rolled directly to the place of storage. In order that the separations may be clearly made and that the longshoremen may not become confused, the transit shed of the pier should be marked off into divisions. The most common and perhaps the best method of doing this is to hang prominent signs down the middle of the length of the transit shed. These are always visible from almost any point in the shed and accomplish their main purpose without being in the way.

Most American piers have a driveway down their center, and it would seem desirable that the truckman keep out of this space by using a passageway along the wall, for this would be more direct and would enable him to avoid the teams. However, he is forced to use the longer congested path, because all the storage space near the wall is needed and because he would cut across the places of discharge of other hatches if he went along the wall. The traveling crane has some advantage here, for it takes the direct path.[4]

Wharf Congestion at Havana, Cuba

The sure and inevitable retribution of wharf congestion that follows the violation of sound wharfinger principles is illustrated by the complete collapse of the Port of Havana, Cuba, during 1920. The original fault, as in all world ports, is the failure of new construction and equipment to keep pace with increased commerce. The last straw that broke the camel's back was a series of longshoremen strikes, yet it would have been possible to carry on and to prevent complete congestion if certain principles had not been violated. These are briefly stated in the following report of the Joint

[4] Taylor, *Stowage of Ship Cargoes.*

Cuban-American Commission and the comments of the writer (R. S. MacElwee) to Joshua W. Alexander, United States Secretary of Commerce, who appointed the American Commission.

The Executive Committee of the American Commission and the Cuban Commission, which have met to consider and recommend measures for relieving the congestion in the Port of Havana, having made a thorough study of the situation, at a number of sessions, unanimously agree to recommend that, in order to relieve the existing congestion in the Port of Havana and to enable importers and merchants to take prompt delivery of their cargo from the piers, wharves, and warehouses in the littoral, the following emergency measures, none of which is contrary to the customs regulations in force, be adopted:

First: Extension of *quedan* [5] to all classes of merchandise, permitting dispatch upon request of the importers in either partial lots or total shipment.

Second: The privilege of partial dispatch be granted, permitting the withdrawal of part of the shipment and basing the duties upon the assessment or appraisal of sample packages, to the extent of about 10 per cent.

Third: That the Customs eliminate minor restrictions, as far as possible, so as to facilitate the granting of *quedan* to all classes of merchandise.

Fourth: That partial clearance and delivery of shipments be allowed at the request of consignee as soon as such merchandise is reported ready for delivery, not subjecting such cases to the procedure of Article 172 of the Customs Regulations, but only to provisional procedure, in order that the goods so requested may be immediately dispatched.

Fifth: That merchandise, other than dry goods, notions, etc., not requiring special examination by the Customs, be cleared and dispatched in the place in which same is discharged from vessel or other water craft, and that such merchandise be duly classified at that place.

Sixth: That the Government authorize the discharge to and place under Customs supervision any and all piers, wharves, or

[5] A certificate of *pro forma* entry at the Customs.

warehouses in the harbor which may be used for the discharge of merchandise in accordance with Customs Regulations.

Seventh: That the collector of customs be directed to dispose immediately of all merchandise now held in store pending sale in accordance with Articles 107, 108, and 109 of the Customs Regulations.

Eighth: (*a*) That the Government allow the establishment of bonded warehouses of any of the classes mentioned in the existing Customs Regulations, so as to make available additional room for storage of goods now on piers, wharves, and warehouses in the littoral [6]; and (*b*) that it authorize and designate private warehouses, stores, etc., as bonded warehouses, to permit the deposit therein of merchandise subject to duty, according to the provisions of Articles 185 and 186 of the Customs Regulations.

Ninth: That the Government commandeer any public property that may be available for the purpose of storing merchandise and have any such property bonded under the Customs Regulations.

Tenth: That in cases where merchandise dispatched by *quedan* is not removed by the owner within the 48-hour period, as prescribed in the Customs Regulations, same shall be subject to the provisions contained in Article 116 of the Customs Regulations.

Eleventh: (*a*) That the Government issue a call to all importers, brokers and others to coöperate with the Government in its efforts to relieve the actual congestion of the port and wharves, by removing immediately—from the piers, wharves, and warehouses located in the littoral, whether public or belonging to private corporations, into which direct discharge of freight from vessels is made, all merchandise that should be removed under the customhouse regulations; and (*b*) that when issuing such call, the Government notify importers, brokers, and others that, after a period of fifteen days from date, Articles 116 and 107, 108, and 109 of the Customs Regulations will be strictly applied to all merchandise on all Government and private wharves and piers at the Port of Havana.

The following recommendations designed to bring relief to congested shipping conditions at Havana Harbor were proposed by the American Committee but were not adopted by the joint action of the Cuban and American Commission:

[6] The "littoral" is the water front where vessels are loaded and discharged.

Paragraph 11.—(*a*) That the Government shall issue a call to all importers, brokers, merchants, and others to remove immediately all merchandise from piers, wharves, and warehouses located within the littoral into which discharge of merchandise from vessels or other water craft is made.

(*b*) That the Government in issuing such a call shall advise owners that if such merchandise is not removed by them from the littoral within fifteen (15) days from date of this call, that the collector of customs shall take possession thereof as unclaimed.

(*c*) That if such merchandise is not removed by the owners within this 15-day period, the collector of customs shall, at the expense of the merchandise, cause it to be removed to warehouses or other places of storage, designated by the Government as available and suitable for such storage.

(*d*) Merchandise designated in subparagraph (*c*) shall, upon the expiration of the 15-day period provided in notice, immediately become subject to storage charges to be collected by the Government in accordance with Treasury Department Circular No. 11, February 1, 1908.

(*e*) In case merchandise is not removed from designated warehouses within statutory period, collector of customs shall take steps to dispose of same in the manner prescribed in Chapter VIII, Article 116, of the Customs Regulations.

Paragraph 12.—Merchandise discharged to piers, wharves, or warehouses within the littoral, subsequent to this notice, and not withdrawn within the usual free time period granted by established dock regulations, shall immediately become subject to provisions of subparagraphs (*c*), (*d*), and (*e*) in paragraph 11.

Paragraph 13.—Until such time as the lighters in the harbor have discharged their present cargoes, there shall be set aside, for their exclusive use for discharge of cargo, wharves additional to those already so used. This will facilitate their discharge and prevent destruction of property that might occur in case of severe storms.

Paragraph 14.—That in order to carry out the emergency measures recommended herein, a highly competent port director or port commission be appointed by the Government with full authority to coördinate port activities and to employ and enforce such other lawful

and practical measures as will result in relieving existing port congestion, thereby insuring an early restoration of an uninterrupted flow of traffic in and out of the port.[7]

The Joint Commission further considers that the present capacity of the public docks of Havana is not in proportion to the increasing traffic of the port, and that, for this reason, any circumstance that produces an interruption in the movement of cargo will bring about a congestion of the wharves.

It likewise considers that the lack of spacious public warehouses for merchandise classed under "general order," is one of the principal causes of the existing congestion, since it is evident that the moderate rates charged by the private wharves induce many importers to leave their merchandise there until they are able to effect its sale.

In consequence, the Commission considers that it is absolutely indispensable that the Government undertake the construction of additional wharves or the enlargement of those now existing, and that it proceed to build, in the business district, large warehouses for the storage of merchandise classed under "general order."

Done in Havana, on the eleventh of August, nineteen hundred and twenty, in the English and Spanish languages.

The Cuban financial situation was adversely affected because of the "frozen credits" in the harbor. This harbor congestion was a powerful contributory cause of the financial panic that followed in October, 1920, the chief cause of which was the decline in the world's market price of sugar.

There are many points involved in the Havana port congestion that every wharf superintendent and port director should take to heart. The full recounting of these reports in this book at this time will show more emphatically than any academic discussion ever can the necessity for keeping wharves clear of merchandise. Transit sheds are for working ships, not for storing merchandise, and the merchandise must be kept moving.

[7] Col. Manuel Despaigne, a member of the Joint Commission, was appointed by Pres. Menocal to this position in December, 1920.

Discussion of Report of the Joint Commission [8]

The nature of the conditions as we found them can be best covered by explaining in detail the meaning and reasons for the report as submitted, a copy of which is attached. The paragraph numbers correspond to those of the report of the Joint Commission.

First: A *quedan* is a certificate of *pro forma* entry, which permits the merchant to withdraw perishable goods by paying 125 per cent of the duty as estimated on the consular invoice. After the duties have been properly calculated, the difference is refunded to the merchant. By interpreting all goods left on lighters or exposed places, and also in the damp climate on the covered wharves themselves, as "perishable," it is possible to extend this *pro forma* entry privilege to all merchandise. It is a matter of interpretation of the word "perishable." This enables the merchant to withdraw his goods immediately and to take care of the customs formalities, which are rather involved, at a future time; the result would be to clear the wharves. Therefore, the extension of the right of *quedan* to all merchandise was the first step in loosening up the customs formalities and clearing the wharves. This was proposed as desirable at the first meeting in your office at Washington.

The privilege of dispatch in partial lots as well as total shipment was extremely important, because the Cuban customs regulations required that a shipment of goods in its entirety be complete at one point and each package separately inspected there, or at specialized customs rooms, by the customs officials before the goods could be dispatched. Due to the congestion and the resulting confusion, particularly the discharge of merchandise upon different lighters scattered about the harbor, it became impossible to gather the goods together at one point. Therefore, by permitting the withdrawal of partial lots, which again was a matter of interpretation of the customs law and not a change in the law, it will be possible for merchants to take whatever goods they can find where they find them and remove them.

Second: The privilege of partial dispatch is reiterated and also it is added that the duty of the goods may be assessed upon sample

[8] Report to the United States Secretary of Commerce, Joshua W. Alexander.

packages, it having been the customs practice to investigate each individual package of a shipment, even though fifty or a hundred packages might be identical. There is nothing in the customs regulation to require this. By using the American method of holding 10 per cent of a consignment for the appraisers, it will be possible for the importer to leave the samples for inspection and appraisal and withdraw the 90 per cent of his goods immediately on a *quedan*.

. . . . . .

Fourth: This paragraph is a further summary of the more specific statements of the preceding three paragraphs.

Fifth: It has been the custom at Havana to send merchandise to certain classified customs wharves to be appraised there. The frequent removal of goods and handling to the various commodity wharves was expensive, even when movement was free and easy, but under present congested conditions it became impossible to do so. Therefore, by permitting or authorizing the inspection of the goods as they lie this handling would be eliminated and goods could be inspected and removed at once. Dry goods are excepted because they would be subject to damage and pilferage if opened on a general wharf.

Sixth: By declaring all wharves "customs wharves" the customs officials and the appraisers could go to any wharf and there inspect the merchandise and thereby avoid the necessity of removing the goods to regular customs wharves. "Customs wharves," therefore, was extended to mean every point where goods could be discharged. This relieves congestion of the established customs wharves. . . .

Seventh: It is estimated that about one-seventh of the space of bulkhead warehouses of the Port of Havana Docks Company is occupied by "unclaimed goods" that have been there from six months to four years. Goods unclaimed and left in the hands of the customs may be taken by the customs at the end of five days, and if not claimed at the expiration of six months are to be sold at auction to cover customs duties and expenses for storage. When the customs auctioneer put these goods up for auction at the end of six months and the bid fell below a sum to cover the customs revenue and the cost of storage, he declared "no sale" and put the goods back in storage for another six months or until some future auction. The customs auctioneer often maintained that there was collusion among

the buyers to keep the price down to an insignificant amount, by which the Government would be the loser. On the contrary, although this may be the case in some instances, it is perfectly obvious that cheese, condensed milk, Mexican beans, which the weavel is sure to get, and many other articles, were worthless at the end of six months and even so repugnant that it would be necessary to hire some one to cart them away. . . .

Eighth: Not only should there be additional Government bonded warehouses, but to oblige the merchants to withdraw their goods, regardless of their convenience, would force many of them into bankruptcy, inasmuch as they were doing business on comparatively small capital and could not afford to pay the customs duties on their goods until such time as the goods had been sold. It is, therefore, proposed that in addition to the creation of more Government bonded warehouses, under Section A, under Section B the existing law be put in force permitting merchants to set aside, under proper restrictions, bonded warehouse space in their own warehouses. This will make it possible for merchants to remove goods in bond to their own bonded storerooms to be "sealed" there. They could, then, carry the goods in bond until such time as they were sold and withdrawn for consumption. In conversation with various merchants this revision was made a special appeal.

Ninth: One of the principal arguments made repeatedly was that the merchant could not move anything anyway because of strikes. The other persistent argument was that there was no place to put the goods, if removed. . . . However, our investigation showed that if the merchants were forced to take the goods they could find a great deal more space than they claimed, but, of course, at a higher expense to themselves than existing private wharf rates. . . .

Tenth: Article 116 of the Customs Regulations provides that, if goods are not removed at the end of a certain time, usually 5 days, they may be seized by the customs officers and put in general stores. In order to force the merchants to make use of the *quedan* once granted, it is agreed that, if they do not exercise the privilege granted in the *quedan*, at the end of 48-hour period, Article 116 would apply and the goods would be seized and put in general stores.

Paragraphs 11 and 12 were the chief bones of contention.

Dating from the days when the facilities of a port were in excess

of its commerce, it has been the custom to permit merchants to allow their goods to remain on the wharves at the exceedingly low storage rate of about 9 cents per 100 kilos per month. (The Government wharves have a charge of 3 to 7 cents per 100 kilos *per day* to force removal.) At the low rate it was cheaper to use the wharves as storage warehouses than to take the merchandise to warehouses. It was necessary, under the circumstances, to devise a punitive charge on goods and store them in some other place in order to leave the wharf free for the transit handling of goods to be loaded or discharged.

Paragraph 11.—The point is the same, namely, that at the expiration of the free time, under the customs regulations, the customs authorities will seize the goods and remove the same to a Government warehouse, the expense being charged to the merchandise. This charge, in the Government warehouse, and also the charge against the goods for removing them, will be a punitive rate that will force the merchants to remove their goods from the wharves at once. . . . The hope was expressed, however, first, that the merchant would not leave very much to be removed, which is the end desired and not the collection of revenue; and, second, that the Government would succeed in finding sufficient warehouse space to which goods could be removed, thus relieving the wharves. Naturally there is an outcry from the merchants that their privilege of leaving the goods on the wharves at low rates is being interfered with. The entire approach to this subject by the committee was: First, that it should be made very easy for a merchant to get his goods; and, second, that if he did not get them and take them away he should bear heavy consequences. It is believed that if the merchants find it is to their great disadvantage to leave goods on the wharves they will find places where their merchandise may be stored. In my opinion, the entire functioning of any port revolves around these two points: First, make it absolutely necessary for a merchant to remove his goods from the transit wharves within a brief period by placing heavy punitive charges against him if he does not do it; and, second, make it as easy as possible to get his goods over the wharves and through the customhouse. Port efficiency, the attainment of a maximum tonnage movement for every linear foot of developed water front, depends upon the proper equipment and *regulations*.

Removal of Goods from Wharves at Philadelphia

With further reference to the necessity of keeping freight moving on the wharves in order to prevent congestion, a contribution is made by the Hon. George S. Webster, while Director of Wharves, Docks, and Ferries of the Port of Philadelphia. Again, it seems more pertinent to quote from actual examples than to discuss the question from the academic standpoint. The particular point to note in this report is the fact that comparatively little freight can be removed from the piers or wharves during the working of the vessel; also the relatively small amount of pier space that can actually be used for the storage of freight. The writer, in *Ports and Terminal Facilities*, calculated an average required floor space for wharf transit sheds to be 10 square feet for each cargo ton of the largest vessel using the wharf. It will be noted that the average floor space actually used at the wharves investigated by Mr. Webster was over 13 square feet. This can easily be explained. In the academic study, based, as it was, on European wide quays and transit sheds, it was found that with these transit sheds constructed 150 to 200 feet wide, only 10 square feet were necessary.

In the cases reported by Mr. Webster the wharf space is entirely too small to accommodate all the cargo. The amount of trucking space, aisles, etc., in relation to the total capacity of the pier is larger than in an adequate shed. Almost as many aisles are required on a pier 75 feet wide as on a pier 150 feet wide—the increased floor area being a clear gain to the storage space of the cargo. With this in mind, the report of Mr. Webster assumes particular interest. It must be borne in mind, however, that conditions vary from port to port and from wharf to wharf at each port as to the percentage of cargo removed from or delivered to the wharf by railroads, lighters, drays, electric trucks, and other devices.

Mr. Webster's report[9] follows:

I hereby submit the following report of investigation of the freight handled on Piers 19, 24, 25, and 27 North, from steamships *Carthaginian*, *Ancona*, *Snowden Range*, *Sloderdijk*, and *America*.

[9] Report of investigation of freight handled on piers 19, 24, 25, and 27 North, as submitted by Assistant Engineer of Department of Wharves, Docks, and Ferries under date of June 19, 1912.

The freight is handled at the above piers to and from the ship by stevedores, on a price per ton basis, which probably accounts for the fact that the freight is, in general, loosely piled on the pier, also that the driveways for teams are restricted, in some cases to 8 feet in width, and generally there are no turn-outs except the openings kept open for the purpose of working the ship's hatches.

Where the freight is of a nonperishable character, few teams, and, in general, none are allowed on the pier for the purpose of removing freight while discharging or loading a vessel, as they interfere with that work.

Weight of a ton taken is 2,240 pounds. This, I am informed, is the weight used by the steamship companies.

The following is a record of freight handled during the period of investigation:

Steamship *Carthaginian* from Glasgow arrived at the north side of Pier 19 North on April 26, 1912. Gross tonnage, 6,096; capacity, 6,000 tons. Length, 386 feet; beam, 45 feet; draft loaded, 25 feet 6 inches; hatches, 4. Reported cargo, 1,800 tons; by calculation, 1,612 tons.

The regular berth for this ship is the south side of Pier 24 North, but as the greater part of that pier was occupied by outbound freight the remaining available space would not accommodate all of the inbound freight, and a portion of it was discharged on the north side of Pier 19 North.

The inbound freight discharged at Pier 19 was burlap, furniture, hides, spiegeleisen, wool waste, potatoes, and potash. That discharged on Pier 24 was fish, beef, fertilizer, and potatoes. The outbound freight on Pier 24 was mainly flour in sacks.

The inbound freight was loosely piled on both piers. A driveway, average width 10 ft., entire length of both piers; truck way along car pits (on Pier No. 19, 5 ft. 6 in. wide) on both sides of Pier No. 24, 7 ft. 6 in. wide; 4 openings for hatches 20 by 30 feet on each pier, and a number of lateral truck ways through freight, cut the available floor space from 30,800 sq. ft. for Pier No. 19 and 58,000 sq. ft. for Pier No. 24, a total of 88,800 sq. ft., to about 22,000 sq. ft. for Pier No. 19 and 34,000 sq. ft. on Pier No. 24, a total of 56,000 sq. ft. The difference of 56,000 sq. ft. available and 48,520 sq. ft. actually covered was used in the case of Pier No. 19 by left-over inbound freight, and in the case of Pier No. 24 with outbound freight that was not taken. Time of unloading, 3 days; loading, 4 days; total time in port, 7 days. Time of moving freight

HANDLING OF FREIGHT FROM AND TO STEAMSHIP "CARTHAGINIAN"

	On Pier Tons	Floor Space Occupied sq. ft.	Vol. cu. ft.	Average Height feet	Floor Space per Ton sq. ft.	Vol. per Ton cu. ft.	Removed from Pier		Delivered to Ship by		
							Teams Tons	Cars Tons	Teams Tons	Cars Tons	Lighters Tons
Inbound Freight											
Pier 19, North Side..	1155	18374	103753	5.6	16	90	760	385	.....	.....	.....
Pier 24, South Side..	657	9534	51450	5.4	14.5	78	300	357	.....	.....	.....
Outbound Freight											
Pier 24	2128	20612	139572	6.4	9.7	63	.....	.....	47	2400	1768
Total	3940	48520	294775	6.0	12.3	74	.....	.....	.....	.....	.....

Total outbound, 4,215 tons; inbound, 1,812 tons.

HANDLING OF FREIGHT FROM AND TO STEAMSHIP "ANCONA"

	On Pier Tons	Floor Space Occupied	Volume cu. ft.	Average Height	Floor Space per Ton sq. ft.	Volume per Ton cu. ft.	Removed from Pier		Delivered on Pier	
							Teams	Cars	Teams	Cars
Inbound										
Pier 19	600	6800	38379	5.5	11.3	60.5	356	270	...	...
Outbound										
Pier 19	128	2048	11059	5.4	16.0	86.4	...	...	158	74
Total inbound and outbound on pier at one time	728	8848	49438	5.5	12.2	67	...	...	...	...

from Pier No. 19, 7 days; Pier No. 24, 6 days. No inbound freight removed from piers until all freight was discharged from ship.

Average number of teams on piers at one time: First day 5, waiting 11; second day 5, waiting 4.

Steamship *Ancona* from Geneva and Naples arrived at the south side of Pier No. 19 North on April 27, 1912. Gross tonnage, 10,000; capacity, 5,400 tons; length, 480 feet; beam, 58 feet; draft loaded, 28 feet; cargo reported, 550 tons. The inbound freight discharged was vermuth, olive oil (in cases and barrels), wine, orris root, macaroni, etc. The outbound freight was oil, cotton, scrap rubber, tobacco, rags, etc.

Delivered to ship from lighters, 579 tons; total outbound freight, 611 tons; total inbound freight, 626 tons. This freight did not cover the south of the pier. Maximum height of freight, 9 feet (macaroni units of about 25 pounds), the minimum, 2 feet 6 inches (oil in barrels on side).

Steamship *Sloderdijk* arrived at south side of Pier 27 North on May 2, 1912; 6 hatches. This ship did not discharge her entire cargo at Pier 27, owing to lack of space. Total cargo reported, 3,400 tons; discharged at Pier 27, 2,850 tons; remainder, 350 tons taken to South Wharves; no outbound freight taken from pier. The freight discharged was cotton bales, cluice (cases), hides (bales), peat moss (bales), rice, starch, waste (bales), wood pulp (bales), alkali (hogsheads), clay (hogsheads), coffee (bags), fish (barrels), glycerin (tanks), etc.

The freight discharged on the second deck was light and bulky, consisting of cotton, peat moss, starch, waste, and wood pulp; that on the first deck, fish, glycerin, lumber, wine, coffee, tobacco, etc. The freight on the bulkhead was entirely fish and oil in barrels.

Time of unloading, 20 hours. No teams permitted on pier while unloading. Time of removal of freight from pier, 6 working days.

Steamship *Snowden Range* from Leith arrived at Pier 25 North on May 5, 1912. The gross tonnage and capacity could not be obtained, but the following measurements were taken: length, 336 feet 5 inches; width, 47 feet; draft loaded 21 feet, light 9 feet 6 inches; 5 hatches; reported cargo, 2,800 tons, cargo by calculation, 2,857 tons. Ninety per cent of this freight was potatoes; balance burlap and fish in cases. No outbound freight taken from this pier,

HANDLING OF FREIGHT FROM AND TO STEAMSHIP "SLODERDIJK"

Pier 27 South Side	On Pier Tons	Floor Space Occupied sq. ft.	Volume cu. ft.	Average Height	Per Ton		Removed from Pier		
					Floor Space sq. ft.	Volume cu. ft.	Teams	Cars	Lighters
Inbound									
Second Deck	689	15215	81881	5.3	22	117	....	...	..
First Deck	1980	20478	134446	6.6	10.3	68	....	...	..
On Bulkhead									
Outside Pier	183	3169	9926	3.1	17.3	54	....	...	..
Total	2852	38862	226253	5.8	13.6	79	1995	797	60

HANDLING OF FREIGHT FROM AND TO STEAMSHIP "SNOWDEN RANGE"

Pier	On Pier Tons	Floor Space Occupied sq. ft.	Volume cu. ft.	Average Height	Floor Space per Ton sq. ft.	Volume per Ton cu. ft.	Removed from Pier		
							Teams	Cars	Lighters
25	2397	30296	179676	5.9	12.6	75	1880	960	17

the entire floor space being occupied with inbound. The ship was required to move to another pier up the river for her outbound cargo.

This freight, being mainly potatoes in sacks of 168 pounds, was piled compactly.

The average driveway for teams was 11 feet. The total floor space of pier, exclusive of 1-track car pit, was 44,000 sq. ft., but this was reduced by driveway, truck passages, and offices to about 31,000. Time of unloading, 35 hours; time of removing freight from pier, 8 working days.

Steamship *America* from Geneva and Naples arrived at south side of Pier No. 19 North on May 9, 1912; 3 hatches. Gross tonnage, 9,000; capacity 5,025 tons, length 500 feet, beam 56 feet 5 inches, draft loaded 26 feet, light 17 feet; reported cargo, 350 tons; calculated, 339 tons. About 60 per cent of this freight was macaroni, the balance cheese, crushed granite in bags, glycerin, olive oil, and tomato paste in cases.

Pier	On Pier Tons	Floor Space Occupied sq. ft.	Volume cu. ft.	Average Height	Floor Space per Ton	Volume cu. ft.
19	339	4436	26949	6.1	13.1	80

SUMMARY

Inbound Freight

Total	8429 tons
Removed from pier while vessels discharging	429 tons
Remained on piers until vessels finished discharging	8000 tons
Floor space occupied by freight on piers	108,302 sq. ft.
Volume of space occupied by freight on piers	626,460 cu. ft.
Average height occupied by freight on piers	5.8 ft.
Floor space per ton occupied by freight on piers	13.5 sq. ft.
Volume per ton occupied by freight on piers	78.3 sq. ft.
Removed from pier by teams	66.5 per cent
Removed from pier by cars	33 per cent
Removed from pier by lighters	0.5 per cent

Outbound

Total	5026 tons
Delivered from lighters over ship's side	2364 tons
Loaded on ship from pier, while discharging	406 tons

Remained on piers until vessel finished discharging...	2356 tons
Floor space occupied by freight on piers when finished discharging	22,606 sq. ft.
Volume occupied by freight on piers when finished discharging	150,631 cu. ft.
Average height occupied by freight on piers when finished discharging	6.6 ft.
Floor space per ton occupied by freight on piers when finished discharging	10 sq. ft.
Volume per ton occupied by freight on piers when finished discharging	66 cu. ft.
Delivered at pier by teams.....	4 per cent
Delivered at pier by cars.....	49 per cent
Delivered at ship's side by lighters.....	47 per cent

The inbound cargoes investigated were a fair average of the general class of inbound freight, except that there were more potatoes received during this time than ordinarily. However, the potatoes were found to weigh 30 pounds per cubic foot as piled on the pier and to occupy about 74 cubic feet per ton. They were piled, on an average, about 6 feet high. The greater part of them was moved by teams, which increased the removal by teams to 66 per cent of the total inbound freight, whereas 50 per cent is a fairer average.

The average removal by cars is 50 per cent. A very small quantity of freight is removed by lighters. The outbound freight investigated was not sufficient to give fair averages. However, from observation, I estimate 50 per cent is delivered directly over the ship's side from lighters, 30 per cent by cars, and 20 per cent by teams over the pier to the ship.

The following conditions are apparent from this investigation. There is but a small percentage of freight removed from the piers while the stevedores are working a vessel, either loading or discharging. This is due to the arrangement of the piers, whereby the teams are driven on the same deck over which the freight is trucked by hand to and from the ship, and, of course, with teams on the piers, the trucking is seriously interfered with and the ship's departure delayed; in the other case, the freight remains until the teams are admitted to remove it, which delays the removal of the freight from the piers one to three days. Furthermore, if the teams had free access to the freight as soon as the ship commenced discharging, in most cases a considerable percentage of freight would be moved before that work was finished, which would effect a saving of floor space.

The average height of freight is 6 feet; volume per ton, 78 cu. ft.; floor space per ton, 13 feet. This indicates that the average

weight per cubic foot is 28 lbs., and with the average height of 6 feet we have 170 lbs. per sq. ft. of floor surface. Thus the piers are loaded to about 50 per cent of their efficiency. The only means to increase the efficiency in this direction would be to increase the height of freight, but the average of 6 feet appears to be the economical height with manual labor. Therefore, to increase the efficiency of the piers, it is necessary that the freight be handled by mechanical means. If a practical overhead device could be installed, the efficiency of piers could be increased by increasing the height of freight and by decreasing the area now required by hand trucks.

As this investigation has been rather brief and confined to a small number of piers, I do not claim that the figures submitted represent an accurate average of the entire freight handled at the Port of Philadelphia, but rather approximate averages. A more thorough investigation, embracing other piers and ships, may change the figures slightly, due to different arrangements.

The subject of the cost of handling freight was not touched in this investigation. A study of this subject would allow a comparison between manual labor and mechanical means for handling freight. If a practical overhead device could be installed, the efficiency of piers could be increased by increasing the height of freight and by decreasing the area required by hand trucks.

In my opinion, from this investigation, there is derived but a small percentage of the total efficiency of the piers.

CHAPTER XV

DELIVERY OF MERCHANDISE FROM THE WHARF[1]

Delivery from Wharf to Drays

Cartage Delays.—The handicap placed upon American business, both domestic and foreign, by cartage congestion at wharves, particularly at the piers in New York, is illustrated by the quotations that follow from correspondence between the writer and certain well-known importing and exporting houses of New York.

Letter No. 1, from W. & G., Commission Merchants:

I inclose, as you suggest, a list of shipments we made during the month of December, showing overtime of 55 hours after 6 o'clock P.M. on the different piers. The list includes the names of concerns for whom the merchandise was shipped [deleted and numbers substituted].

The overtime hours do not in themselves indicate the number of hours our trucks spent on the piers awaiting unloading, but merely cover the hours spent after 6 o'clock. Many of these trucks have reached the docks as early as 10 o'clock in the morning and remained there until 10 and 12 o'clock at night, and where they have reached the docks as late as 4 o'clock in the afternoon, they have, in a few instances, been compelled to wait until the early hours of the morning to unload.

I will be pleased to furnish you with any further details that will aid you in correcting the evil.

Letter No. 2, from G. B. & Co.:

Of almost equal importance at the present time is the question of a system of terminals to which points all freight could be consigned for reshipment. With conditions as they are to-day, the expense involved in bringing all packages to warehouse for the

[1] By R. S. MacElwee.

OVERTIME ON EXPORT SHIPMENTS

Firm	Shipped	Pier	Hours
1	Dec. 2, 1919	Pier 33 Brooklyn	2
2	Dec. 2, 1919	Pier 15 Hoboken	3
3	Dec. 3, 1919	Pier 45 Brooklyn	3
4	Dec. 3, 1919	Pier 63, N. R.	1
5	Dec. 3, 1919	Pier 9 N. R.	1
6	Dec. 3, 1919	Hoboken	2
7	Dec. 4, 1919	Pier 9 N. R.	2
8	Dec. 6, 1919	Pier 2 Bush D.	4
9	Dec. 6, 1919	Pier 2 Bush D.	
10	Dec. 8, 1919	Pier 42 N. R.	1
11	Dec. 8, 1919	Pier 13 E. R.	4
12	Dec. 9, 1919	1 Bush Docks	8
13	Dec. 9, 1919	1 Bush Docks	
14	Dec. 9, 1919	1 Bush Docks	
15	Dec. 9, 1919	1 Bush Docks	
16	Dec. 9, 1919	1 Bush Docks	
17	Dec. 10, 1919	1 Bush Docks	2
18	Dec. 18, 1919	17 Hoboken	1
19	Dec. 22, 1919	13 E. R.	5
20	Dec. 23, 1919	2 Empire St.	1
21	Dec. 24, 1919	3 Empire St.	2
22	Dec. 24, 1919	3 Empire St.	
23	Dec. 24, 1919	31 N. R.	4
24	Dec. 26, 1919	34 Atlantic Docks	3
25	Dec. 27, 1919	Bush 3	4
26	Dec. 27, 1919	17 Brooklyn	1
27	Dec. 27, 1919	3 Bush Docks	1

purpose of determining whether they are properly packed, and in holding them pending the sailing of steamers, is a very large one, frequently all out of proportion to the value of the merchandise shipped. We have very often found this to be the case when it comes to such goods as cheap glassware or woodenware and bulky toys. Frequently a barrel of glassware does not cost more than $10, whereas the lowest possible charge for carting the goods to the warehouse and, later on, from warehouse to steamer amounts to $1.50 alone, that is, quite aside from the handling charges and warehouse expenses, which often aggregate as much as 30 and 35 per cent of the value of the merchandise itself. This has been a very sore point with many of our export customers; in fact, it is hurting business. The creation of terminals would, of course, greatly reduce these charges.

Another matter, which has been quite serious of late, is that teams are kept waiting on the docks so long before they can discharge

their loads. While I have not any remedy to suggest, I do not wish to fail to bring the point to your attention.

In another letter dated, May 20, 1920, some actual examples are given:

It has been our experience that, while the actual cartage and drayage costs are high, it is the overtime charges which are "the last straw that breaks the camel's back," so to speak. For instance: On January 7 we delivered 126 packages to a certain line in New York, on which the truckage was $58.40, on which the overtime was $54 (36 hours).

On January 17 we forwarded 17 packages to another line in this city on which the truckage was $6.80 and the overtime $9.

These are just two examples taken at random, to show that the overtime charges very often amount to more than the truckage charges. We will cite you a few excerpts of letters from our customers in regard to cartage charges, which you understand is always added to our invoices, our merchandise being sold "f.o.b. factory" or "f.o.b. house."

"Regarding your charge of $50.40 for overtime due to delay of truck at pier, we highly appreciate your good desire to give attention toward us, but in this particular case you understand it is impossible for us to allow this charge, and, therefore, cannot recognize the charge."

Another letter from an export company in New York:

"In regard to your charge of November 24, $15, and November 18, $25, we have invoices covering these items. However, we have not as yet seen fit to pass same to the credit of your account. It seems to us that out-of-the-ordinary conditions which would entail extra cartage expense is a matter which you as vendor should take into consideration when making quotations. It should be treated as an overhead expense rather than a trucking charge."

As there is keen competition in all our lines, as well as in others, exporters of manufactured merchandise are unable to include in their quotations a leeway to cover cartage or packing, and inland freight charges, and all our orders are taken subject to these charges. Sometimes they are high and sometimes they are low, but in a great many cases where they are high customers simply deduct these charges, and we can safely say 80 per cent of our export claims are

due to this matter of excessive charge on cartage and drayage, which we must pass on to the customer, or else very often lose our own profit.

Another example of a shipment amounting to $466.31, for San Juan, P. R.; the truckage charge was $8.60; the overtime was $19.20.

Another shipment for Mayaguez, P. R.; insured value of merchandise, $600; overtime cartage charge, $50.40.

As said before, it is the overtime that is the bad feature of this, and in our opinion it is due to insufficient dock and terminal facilities. Our customers do not hesitate paying the usual and fair charge for cartage from our house to pier, but when our trucks must stand in line sometimes for 36 hours, in order to make this shipment possible it naturally seems unreasonable to the customer, and is the cause of all these aggravating claims.

We recently have been shipping a lot of merchandise through New Orleans, and the charges from that port have been very much lower than from New York, due to the terminal facilities of that city.

Relief through a Store-door Delivery System.—The relief for cartage congestion is some uniform trucking system combined with store-door delivery. By "store-door delivery" is meant the application of the letter-carrier principle to incoming package freight, particularly less than carload lots. In larger towns the population would not think of going to the post office and standing in line to get their letters; yet, this is exactly what we have forty thousand or more trucks doing in New York every day. There should be some system of delivery by which the packages would be carried to the door of the consignee at once upon arrival, thus clearing the wharves more rapidly and relieving the congestion caused by many half-empty trucks waiting to pick up their various pieces of freight. One of the prime movers in the agitation for store-door delivery has been G. F. Hichborn, General Traffic Manager of the United States Rubber Company. This method is briefly described in the following report:

The committee upon store-door delivery of the Federal Highway Council Convention at Akron, Ohio, of which the writer is chairman, submitted the following findings:[2]

[2] Mr. Beck, of Baltimore Merchants' Association, read a paper upon store-door delivery, before the meeting of the Federal Highway Council in New York, December 10, 1920, that may be had from the Council. This is the best presentation to that date.

REPORT OF THE SUBCOMMITTEE ON STORE-DOOR DELIVERY

Mr. Chairman, the subcommittee wishes to report as follows:

In submitting this to you, however, I wish informally to express the opinion of the committee that, providing this report be accepted, the committee be kept intact in order to go further and make a more lengthy report upon this matter.

Preamble

In many cities traffic has outgrown the freight terminal facilities. Methods must be found for more intensive use of existing facilities by handling more shipments per day over the same platforms.

Recommendations

It is therefore suggested by the committee that that part of terminal congestion caused by cartage difficulties, may be relieved by the inauguration of some system of immediate delivery to the consignee of incoming freight.

This may be accomplished by the following plan:

The municipal area should be divided into zones of delivery.

The shipper will be required to mark the package and shipping papers with the street address of the consignee. The railroad agent at point of origin will add the zone, from a guide book supplied for the purpose.

Where the delivering carrier has two or more stations in the area, the station nearest the zone in which the delivery will fall will be designated. Goods upon arrival will be unloaded at the designated station.

The freight house at destination will be divided into sections corresponding with the zones of the city and freight on arrival will be placed in these sections, grouped according to blocks in the zone and ready for delivery to the tracks.

The freight terminal will be served by a single consolidated trucking service, whose trucks will travel over prescribed routes.

No outside trucks will be permitted to call at L. C. L. platforms.

As trucks arrive they will be fully loaded and immediately dispatched.

All freight charges as indicated by the railroads, and also cartage charges, will be collected from the consignee by the consolidated

trucking service. For this collection the consolidated trucking service shall give a bond satisfactory to the railroad companies.

A reasonable tariff of charges for delivery should be published and filed with the proper authorities. The rate should be commensurate with the service, calculated for each zone, and such rates would be similar for all terminals within each zone. The cartage charges should be in addition to the freight rate.

So far as possible, mechanical means should be installed for the handling, loading and dispatching of the trucks.

The above deals entirely with less-than-carload freight, and it is the thought of the committee that carload freight be not considered at this time.

After once establishing the inbound trucking service to the consignee, a further study should be made for the pick-up freight service for outbound shipping.

(*Signed*) R. S. MacElwee, *Chairman.*

In conclusion, it would seem that one of the principal problems confronting all wharf administration to-day is the question of cartage and the rapid delivery of freight to the cart, in order to relieve the wharf and also to reduce the terminal expense. Whether this expense be borne by the wharf operator, the steamship line, or the shipper, it all weighs upon American foreign trade and makes American business less able to compete in foreign markets. The prosperity of the steamship line in the end depends upon the movement of freight, and this movement of freight depends upon American competitive ability in the foreign market. It is, therefore, decidedly the problem of the wharf superintendent to see that all expenses, whether borne by his organization or not, are reduced to the minimum.

Delivery from Wharf to Railroad Car

In every port a large proportion of incoming freight is delivered from the wharf to railroad cars. At New York the lack of a harbor belt-line railway is met by the lighterage system. Although the lighterage system necessitates a rehandling of the goods between the railroad car and the lighter and is, therefore, very expensive, for the present it is a substitute for a belt railroad and does afford flexibility in the connection between every wharf and every railroad

system. In a thoroughly modern port, however, there should be a belt-line railroad that would make it possible to switch freight cars, loaded or unloaded, between any wharf and any railroad serving the port. If the port is laid out on the pier system, a good example are the piers at the Norfolk Army Supply Base and at Philadelphia. At these points the piers are made double width and the spur tracks extend down the center of the pier. This makes it possible to truck freight a short distance to and from the assembling piles and the door of the box car on the inshore side of the pier deck.

This delivery may be by hand truck, trailer truck, electric lift platform truck, by gravity roller conveyors, or by portable belt conveyors. The movement between car and pile on the pier is entirely similar to the movement between the pile on the pier and the picking-up point at ship's side. Car loading, however, is not quite so important a process as stowing a ship, yet it requires care. Consider, therefore, that the pier is of the Philadelphia type or of the quay system, with the car track opposite the ship and the transit shed between. It will be found that in delivering freight to the pier it is impossible to drill railroad cars in and out of the pier and discharge them as fast as the ship can load. Conversely, it will also be found that a ship can discharge much more rapidly than the freight cars can be loaded and removed from the point where they are spotted across from the ship. There must always be taken into consideration the reservoir principle of the transit shed. Freight from railroad cars must be assembled in advance of the loading of the ship; also the delivery of freight to the cars will not usually be directly from the ship's hatch across the wharf.

In most wide piers or quays the side of the transit shed opposite the ship is served by both the railroad track and a road for drays. There results an inevitable interference between railroad freight and cartage freight. This is avoided by delivering to carts during the day working hours and to railroad cars during evening or extra-time hours. At the terminal in Cleveland, Ohio, the lake vessels discharge their cargo into the transit sheds on the pier; these are served by a wide street and railroad tracks down the center of the pier. In this particular case the drays for local delivery receive their freight during working hours until 5 o'clock in the afternoon.

A still better layout would be with team platforms at the bulkhead and trailer truck or telpher service between the pier and

bulkhead for team loading, leaving the car tracks in the center of the pier entirely for railroad freight at all times.

Loading Box Cars.—The correct loading for box cars is a matter that requires considerable study. The suggestions and diagrams furnished by the American Sugar Refining Company are quoted herewith *in extenso*. Although these instructions do not cover all classes of freight they show the loading of box cars with various types of containers and should be suggestive of the more complete study and better general methods of delivering freight from the wharf to the car.

General Instructions

Car Loading—*Selection of Cars.*—Sugar must be loaded in perfectly tight, dry, and clean cars. Cars with end doors, end windows or ventilators must be thoroughly protected around openings with waterproof paper and boards.

Cars with double side doors may be used for loading barrels and cases, rejecting those where door strips cannot be applied. Refrigerator and produce cars may be used for barrels and cases, but only those that are absolutely free from odor and when openings are thoroughly protected.

Inspection.—Cars must be thoroughly inspected for defects in roof, sides, ends, doors, floors and fastenings. Protruding nails must be removed. Sweep all cars and eliminate every evidence of dirt, oil, acid, moisture or other conditions which are likely to damage sugar. If any unfavorable conditions prevail that cannot be overcome with suitable dunnage, reject the car.

Distribution of Load.—No truck of any car should carry more than one-half of the marked capacity plus 10 per cent for overload. The lading must be so placed that there will not be more weight on one side of the car than on the other.

Dunnage.—Dunnage boards, where required, must be of the necessary length, not less than one inch thick and five inches wide.

Cleats, where required, must not be less than 2 by 4 by 8 inches, of sound material and secured by four 3-inch nails. When necessary to nail cleats to lining of box cars having steel superstructure without exterior siding, the nails must not be driven entirely through the lining of the car.

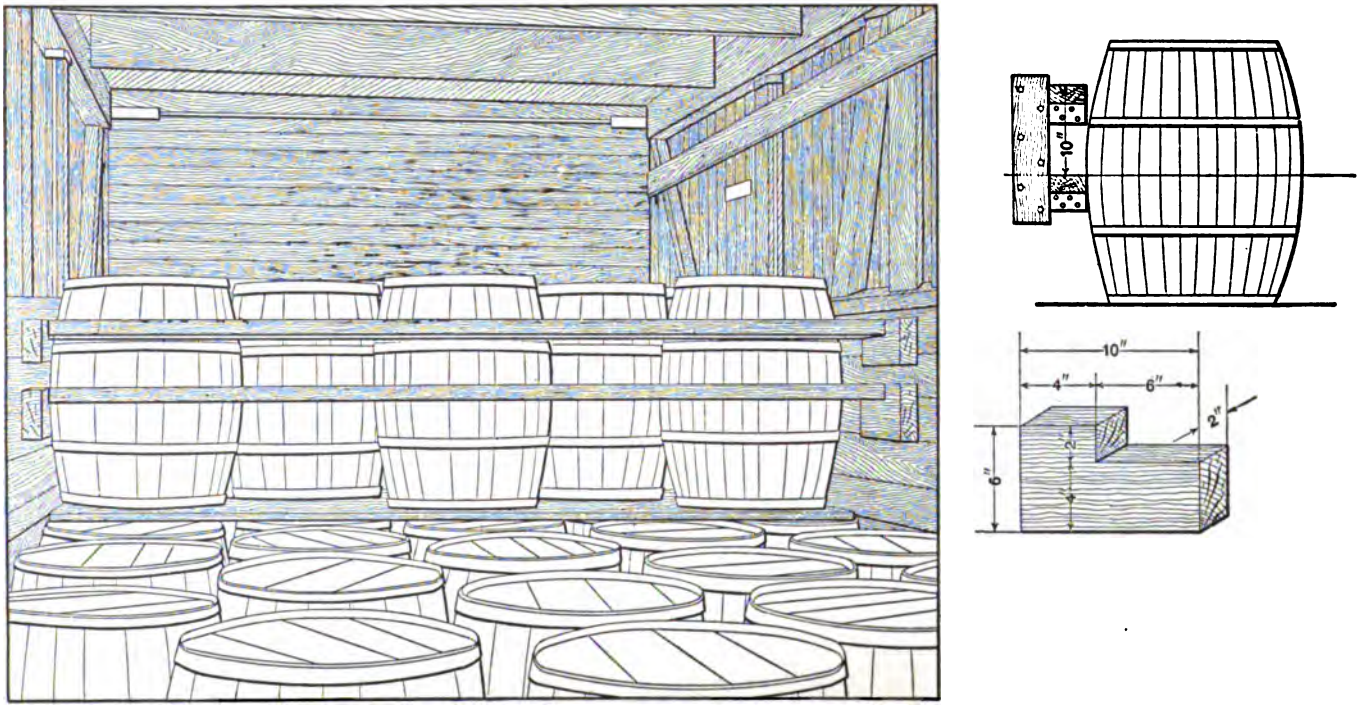


FIG. 88.—ILLUSTRATING CLEATS AND CHOCKING. (*Courtesy American Sugar Refining Co.*)

Chocking cleats, where required, must be of 2 by 6 inches, straight-grained, sound material, 10 inches long with cut-out 2 by 6 inches to receive end of chocking board, placed with cut-out toward back of car and secured with six 3-inch nails (Fig. 88).

If facilities are not at hand for cutting this cleat, a substitute may be used consisting of plain cleats 2 by 4 by 6 inches, on top of which the chocking board must be secured. In front of upper and lower cleats, nail a protecting strip 2 by 4 by 18 inches, secured by six 3-inch nails.

Chocking material, where required, must be of straight-grained sound lumber, not less than 2 by 6 inches and of necessary length.

Door strips, where required, must be of straight-grained, sound lumber, not less than 1 inch thick by 6 inches wide, with 3-inch lap on door post secured by three 3-inch nails, each end of strip nailed to inside of door post, placed sufficiently close to floor of car and to each other to prevent lading from falling or rolling out of car or coming in contact with door.

Dunnage paper, known as weather-proof rosin-sized building or rag sheathing paper, where required, must be of sufficient weight and thickness fully to protect lading against absorption of moisture or contamination.

Assorted Car Loading and Less than Car Loading.—Due to variations in size of orders and dimensions of cars, it will be necessary at times to work out slight changes in the methods set forth. Otherwise assorted car loading and less than car loading must follow standard methods hereinafter shown for each kind of package. Containers and cases must be loaded at end of car, followed by bags or sacks, placing barrels through center in a manner to be "self-chocking." Packages of dimensions other than those illustrated must be loaded to conform to standard methods (Figs. 89, 90, and 91).

Barrel Loading.—Barrels must not be rolled on bilge. Stowing in cars must be on heads only, in all tiers. Barrels of powdered or cube sugar must not be placed in first tier under heavier barrels when second tier is necessary.

Bag or Sack Loading.—Keep bags or sacks away from sides and doorways. Floors and ends of cars must be covered with dunnage paper. If doors do not close tight, protect by nailing a door strip at floor. Hooks must not be used in handling bags or sacks (Fig. 92).

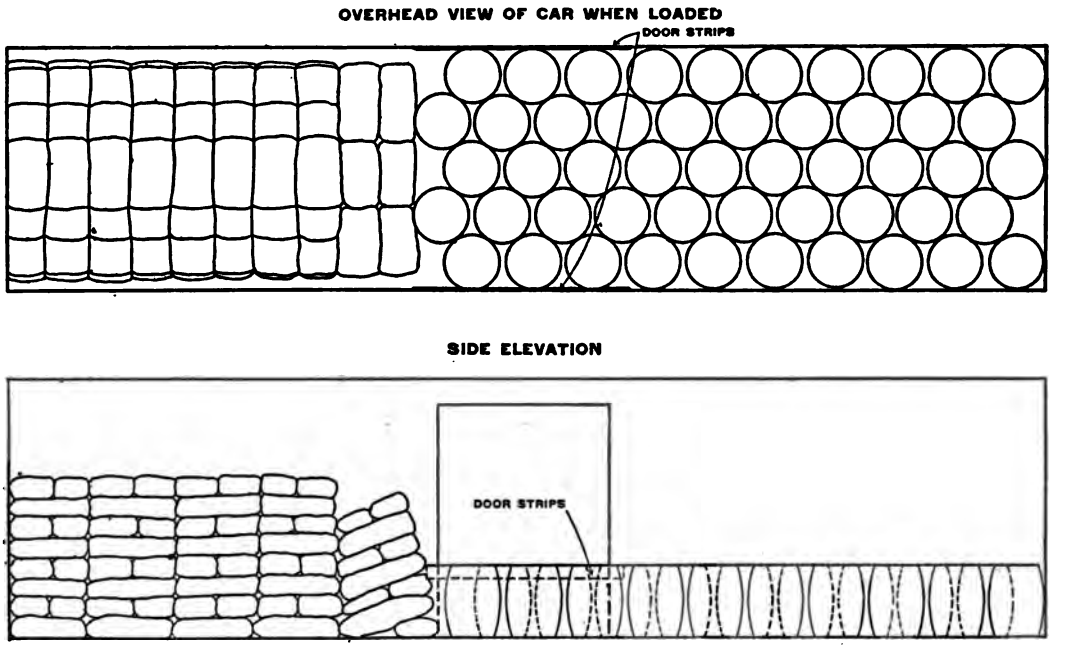


FIG. 89.—METHOD 5.

ASSORTED LOADING—200 BAGS OR SACKS AKD 50 BARRELS IN 36-FOOT CAR. Bags or sacks at one end, four stacks of 42 and end stack of 32. Barrels all on floor. Nail door strip on each door. If it is desired to increase number of barrels, they should be placed in second tier as in Method 1, plate 1. If more bags or sacks are required, increase size of stacks as per table, plate 5.

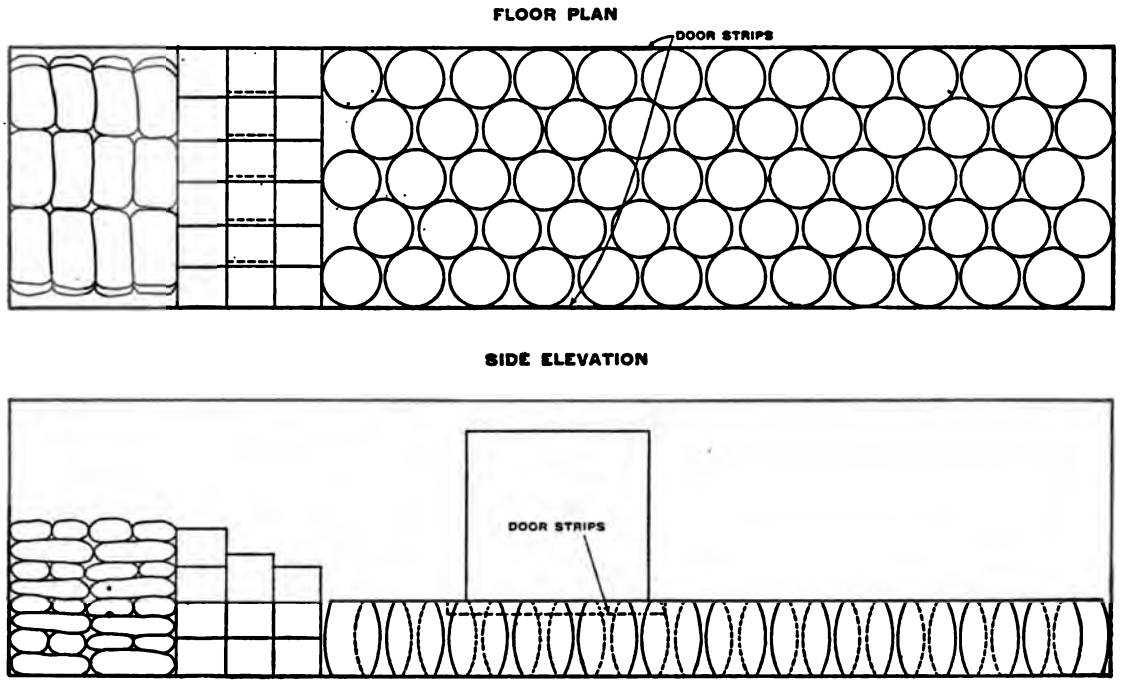


FIG. 90.—METHOD 8.

ASSORTED LOADING—100 BAGS OR SACKS, 60 CASES DOMINO GRANULATED AND 60 BARRELS—36-FOOT CAR. Load bags or sacks in end of car, cases next, barrels on floor in center of car. Nail door strips on each door.

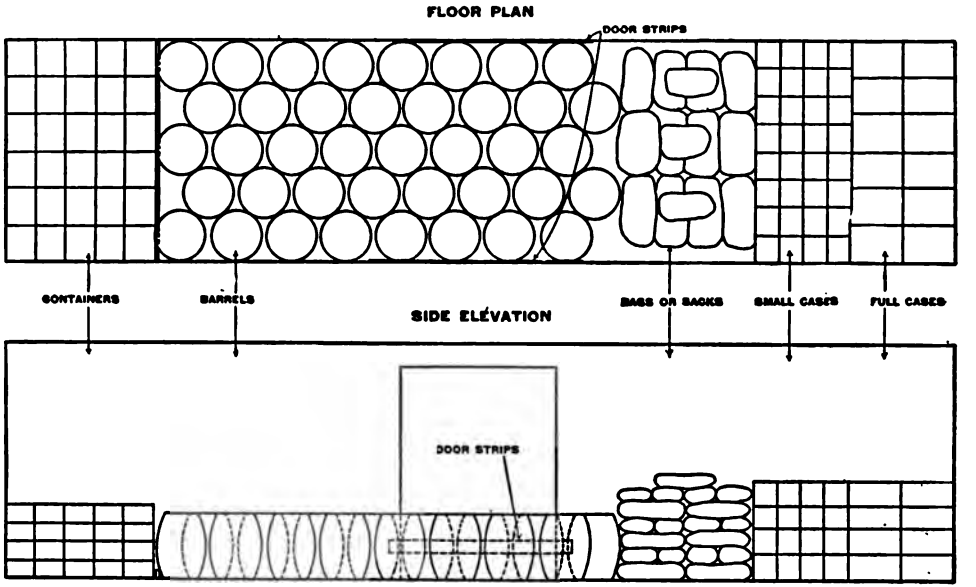
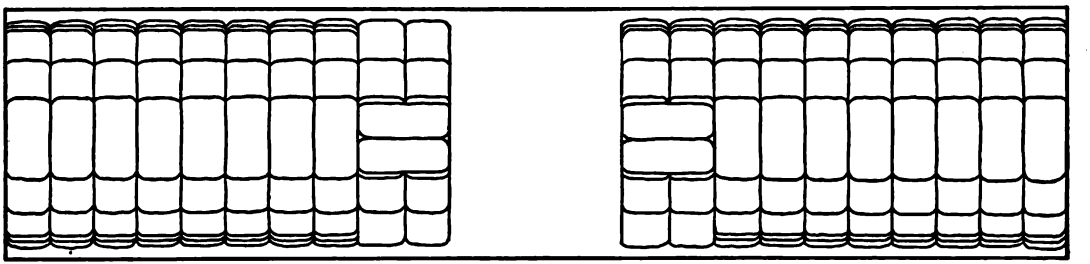


FIG. 91.—METHOD 13.

ASSORTED CAR LOADING	65 BAGS OR SACKS 120 CONTAINERS, 16 3½-LB. GRANULATED 48 FULL CASES CRYSTAL DOMINO TABLETS 128 SMALL CASES CRYSTAL DOMINO TABLETS 40 BARRELS	36-FOOT CAR

Load containers at one end, 6 wide, 4 high, 5 rows. Load full size cases at opposite end, 6 wide, 4 high, 2 rows. Load small cases 8 wide, 4 high, 4 rows. Load bags or sacks next to cases. Load barrels in center on floor,—"self-chocking." Nail door strips on each door. Nail floor strip in front of containers, one inch thick and three inches wide across car.

OVERHEAD VIEW OF CAR WHEN LOADED



SIDE ELEVATION

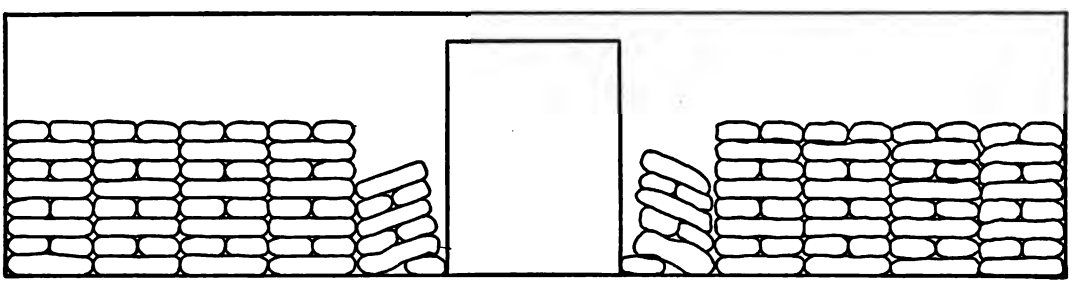


FIG. 92.—METHOD 4.

TYPICAL BAG OR SACK LOADING

400 in 36- or 40-foot car. Requires 4 stacks of 42 and end stack of 32 at each side of door.
500 in 36-foot car. Requires 4 stacks of 54 and end stack of 34 at each side of door.
500 in 40-foot car. Requires 5 stacks of 42 and end stack of 40 at each side of door.
To load in excess of 500, stack higher.

Case Loading.—Cases must not be loaded on end or sides except where necessary to turn one row of top layer to act as chocking. If car doors do not close tight, protect by door strip at floor.

Container Loading.—Floors, sides and ends of cars must be protected by dunnage paper. Load containers with sealed end in horizontal position, piling true and even to prevent cutting or crushing of edges and corners.

Load small quantities in assorted cars with same care.

Solid cars of containers must be protected at doorway, such protection extending one foot each side, by a flooring of dunnage boards, laid two inches apart, crosswise of car. If car doors do not close tight, protect by door strip at floor. Hooks must not be used in handling containers.

Delivery from Transit Shed to Warehouse

This movement presupposes the proper construction of wharves with adjacent warehouses as described in the chapter that follows. The adjacent or water-front warehouse is a comparatively new development in American port design. It is obvious that the distances from wharf to warehouse are too great for economical trucking by man power with the small hand truck. As stated above, the longer distances are covered better by tractors and trailers, by electric lift platform trucks, or by overhead conveyor or man-trolley system.

The construction of the upland warehouse with many stories makes the vertical movement as important as the horizontal movement. In the chapter on "Warehousing" in *Ports and Terminal Facilities* (1918), the writer stated that the interior elevation was uneconomical compared with the whip-and-fall or winch-and-tackle system outside the warehouse. This statement was made before the introduction of the large platform elevator with an automatic leveling device. The writer has based his opinion upon considerable experience in the elevator-construction industry prior to the time of the invention of this automatic floor-leveling device. The great warehousing systems in Manchester, Liverpool, London, and particularly at Hamburg, had all found that interior elevation was uneconomical and that the electric winch, with a fall from a projecting beam over the doorways of the warehouse, was the most simple and rapid

method. In some cases, for instance where water-side delivery from different parts of the harbor is possible and goods come under the gable beams of the warehouse in lighters, the drum-and-fall system of hoisting to upper floors outside the walls of the building is still to be preferred. But where it is possible to load small platforms or trailers in the transit shed and tow them by means of some type of electric truck directly into the warehouse adjacent to the wharf, the interior elevation has become possible through the invention of the microleveling elevator. The automatic or microleveling elevator is the combination of the push-button control with a secondary automatic leveling device. The latter consists of a small motor that is immediately set in operation and moves the elevators very slowly when the platform of the elevator varies more than half an inch from the level of the warehouse floor.[3]

A large platform carrying perhaps a tractor and five trailers will be dispatched to the desired floor by pushing a button that actuates the automatic control. There is nothing new in this, as all Europe is supplied with push-button passenger elevators, and many New York residences have them. The elevator stops automatically approximately level with the floor indicated. If the elevator does not exactly register with the floor the elevator platform makes electric contact with certain control switches. This closed circuit sets in motion a small motor that moves the platform slowly until it reaches the floor level, where the contact is broken and the platform makes a perfect stop. If a large platform is loaded with a heavy weight the ropes will stretch. Formerly with the hand-switch control it was necessary for the operator in the elevator to giggle the elevator upward and downward to overcome the stretch in the rope. With the new device, as soon as the platform settles the contacts are made that set the microleveling motor in motion, and this brings the platform back to the proper level. Heavily loaded trucks coming upon the elevator will sag the rope, yet the adjustment is so rapid that before the following truck enters upon the platform the proper level will have been reëstablished. This system of interior elevation by large platform elevators, in connection with the microleveling device, has entirely revolutionized the possibilities of water-front construction.

[3] Full description of the mechanics of this device can be obtained from the Otis Elevator Company.

The problems of water-front design with proper regard to warehousing and in-transit storage that will make possible a higher utilization of water front were discussed in the December, 1920, monthly of the American Association of Port Authorities.

CHAPTER XVI

WAREHOUSING AND STORAGE

The following opinions from the best authorities will describe warehousing in various details.

Warehousing

Requirements of Facilities.—Buildings and floors must be clean and dry, free from all liability of damage from floods or contamination and moisture. All evidence of dirt, filth, oil, acids or other substances likely to damage sugar must be removed.

Barrels, bags, sacks, cases and containers must be handled in a manner which will insure their delivery to the purchaser in a clean and perfect condition.

Passageways must be maintained to allow free inspection.

Each lot, mark, size, brand or kind of package must be stored separately as shown on invoices, in order to preserve the identity of the shipment.

Withdrawals.—Orders must be clear and accurate to prevent confusion in withdrawing lots, grades, sizes, or kinds of packages.

Lot numbers specified must be withdrawn as instructed. Never substitute other lots (even though of same grade, size or kind of package) unless authorized. Complete delivery of the oldest lots must be made before beginning withdrawal of new stock, unless instructed otherwise.

Account of Stock.—Upon request, the warehouse shall furnish to the company a report of the stock on hand, showing each individual lot, mark, grade and package, which should agree with the warehouse office records.

Auditors of the company shall have access to the warehouse and records to verify the account of stock and for inspection.

Records must be kept in such a manner that they can be balanced without loss of time.

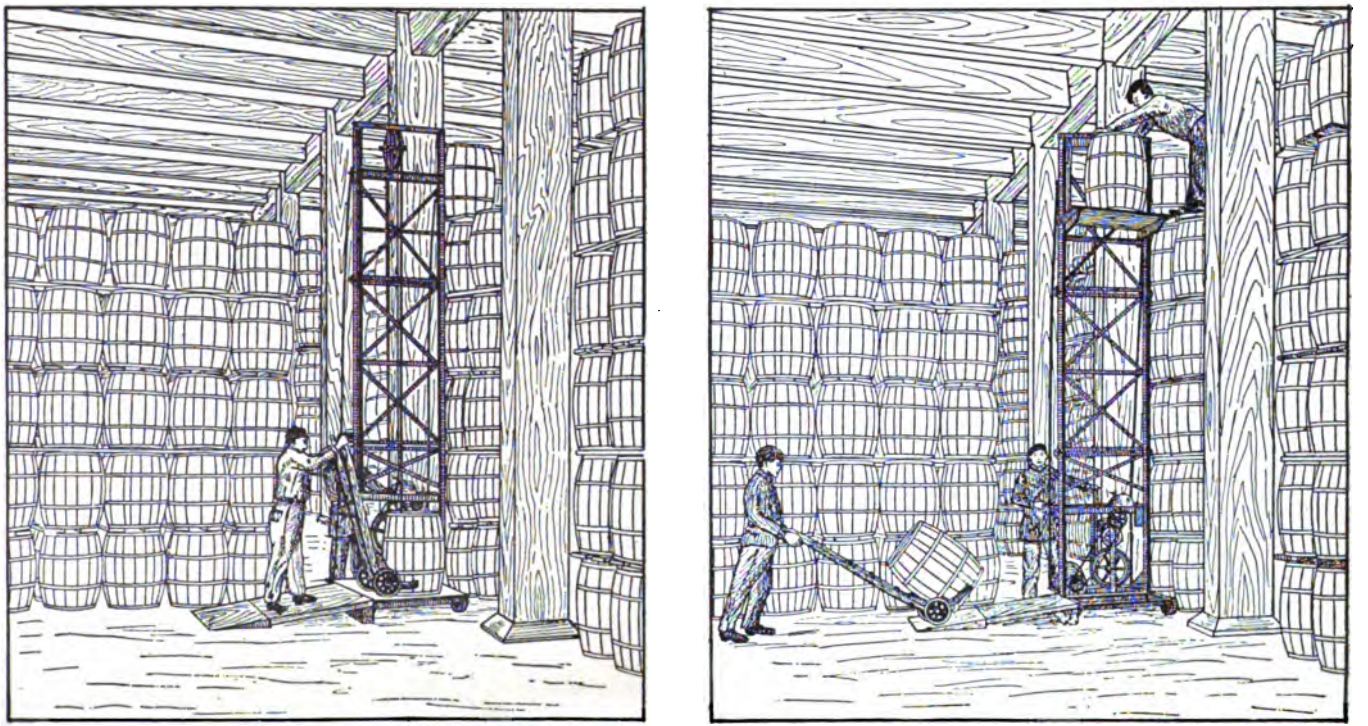
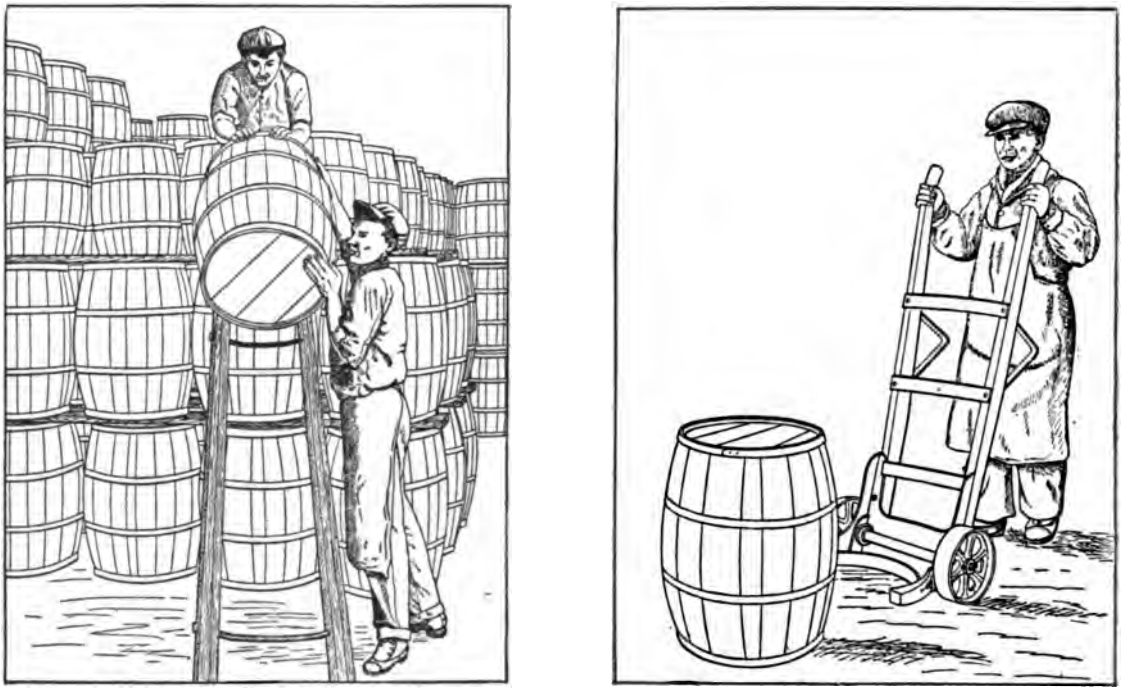


FIG. 93.—WAREHOUSE METHODS. Portable electric tiering machine for piling and breaking down barrels. (*Courtesy American Sugar Refining Co.*)



(*Courtesy American Sugar Refining Co.*)

FIG. 94.—WAREHOUSE METHODS. Figure 1. Barrels on heads with dunnage between tiers, and breaking down pile by use of double skids. Figure 2. Approved type of hand barrel truck.

Receipts.—Proper and complete receipts must be obtained from transportation companies, draymen or others concerned, fully to protect the Company against loss.

Barrels.—Barrels must not be rolled on bilge.

Barrels must be set on heads in all tiers. Between each tier place two dunnage boards, not less than one inch thick by five inches wide, under each barrel. When breaking down from piles, use sliding skids or mechanical devices positively to prevent dropping.

Bags or Sacks.—Great care must be given to the storage of bag or sack sugar. Floors must be thoroughly clean and sound, free from nails and other projections, and covered with heavy or waterproof paper. When these conditions do not prevail, or when floors are of concrete, use clean dunnage boards laid on timbers to keep bags or sacks free from damage or contamination. Pile in orderly manner, cross-tie ends and corners. Sacks containing small bags must not be piled higher than ten feet. Do not pile against walls or partitions. Hooks must not be used in handling bags or sacks.

Containers.—Use same care and preparation of floors as for bags or sacks. Pile only on a level surface. Pile all containers with sealed end in horizontal position. Pile true and even to prevent cutting or crushing of corners or sides. Do not pile in excess of five feet in height. Use heavy paper between alternate layers as a binder to hold containers in position. Do not handle in slings. Protect bottom layers from damage by trucks by placing boards at corners and sides. Hooks must not be used in handling containers.

Cases.—Cases must not be piled on sides or ends. Do not handle in slings or on slides. Do not pile in excess of six feet in height.

STORAGE

NOTES

1. The instructions which follow are almost in entirety reprinted from Storage Committee Bulletin No. 7, written by Henry Wood Shelton, Assistant Professor of Business Organization and Management at the Amos Tuck School of Administration and Finance, Dartmouth College, Hanover, N. H., and issued by The Storage Committee of the War Industries Board, Council of National Defense, 5216 New Interior Building, Washington, D. C.

2. A few additions and some changes in arrangement have been

made, but these are so inconsequential that entire credit for these storage instructions is due Professor Shelton.

3. The terms used in stowing have never been generally standardized. The meaning of such words as item, lot, unit, tier, block, stack, etc., are but vaguely comprehended, largely because of ambiguity in their use. The definitions given are offered as one step toward a generally recognized nomenclature, necessary for accurate instructions.

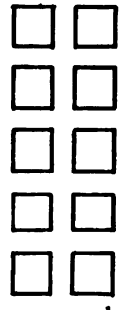
DEFINITIONS

1. *Article:* Any single piece: *e.g., 1 can,* canned corn, No. 2 size can, xyz brand.

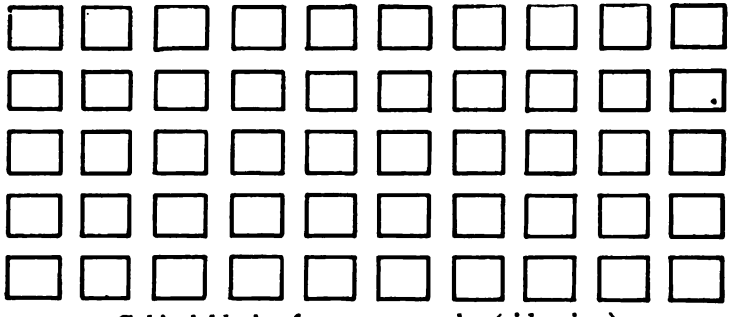
2. *Bin:* A receptacle for holding articles, formed of parallel shelves—one above the other—divided by vertical partitions.

3. *Bin-insert:* A removable frame for subdividing a bin.

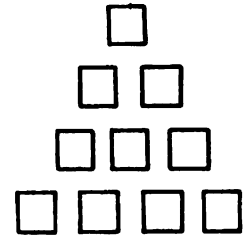
4. *Block:* A self-supporting regular pile, two or more wide, two or more deep, and two or more high. A block may be either *cubical* or *pyramidal.*



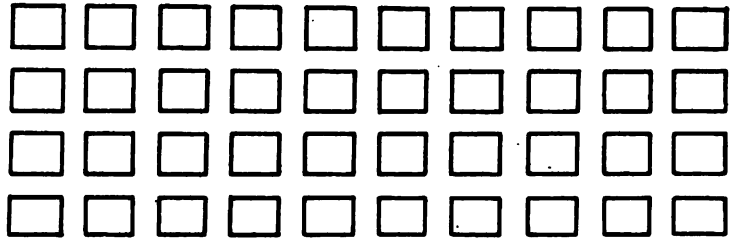
Cubical block of 100—stack of 10 (end view)



Cubical block of 100—10 stacks (side view)



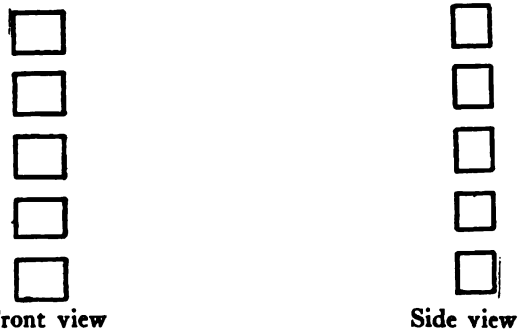
Pyramidal block of 100—1 stack of 10 (end view)



Pyramidal block of 100—10 stacks of 10 (side view)

5. *Bulk-Spaces:* The storage space set aside for the bulk of an article, and from which supplies are drawn for issue or shipment in large quantities, or for replenishment of issue-bins and reserve-bins.

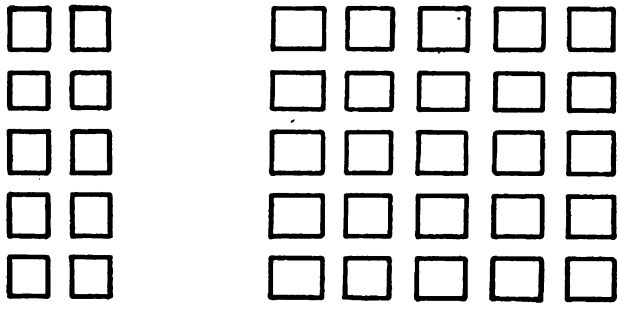
6. *Column:* A vertical, self-supporting, regular pile, one wide, one deep, two or more high.



Front view Side view

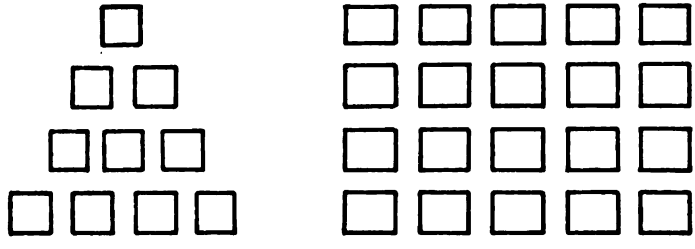
Column of 5

7. *Course:* A horizontal layer of a block (cf. the *courses* of a brick wall). Courses are numbered from the bottom up.



End view Side view

5 courses of 10 each in a cubical block of 50



End view Side view

4 courses of 20, 15, 10, and 5 respectively in a pyramidal block of 50

8. *Issue-Bins:* A bin from which supplies are ordinarily issued or assembled for delivery or shipment.

9. *Item:* Any one kind of stores to be put in one place, *e.g.*, *canned corn*, No. 2 size cans, xyz brand. Difference in size, shape, nature, quality, weight, color, make, brand, or style, will generally determine different items.

10. *Lot:* A quantity received and stowed at any one time, *e.g.*, *50 cases*, 24 in case, canned corn, No. 2 size cans, xyz brand.

11. *Pile:* A heap, irregular in shape. Regular piles are defined under column, stack, and block.

12. *Platform:* A level surface parallel to the floor; a platform may be either large or small, high or low, movable or stationary. The term platform, therefore, includes all mezzanine floors.

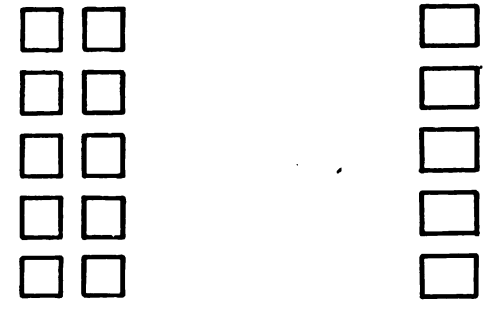
13. *Rack:* A framework for holding articles whose principal

dimensions are length and width—or length alone—such as metals in bars; metals in sheets, oars, pipe, etc.

14. *Reserve-Bin:* A bin in the immediate vicinity of the issue-bin, from which the issue-bin draws its stock.

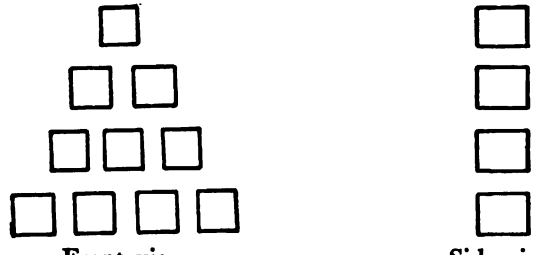
15. *Row:* A uniform arrangement of bins or racks extending from main-aisle to wall. Rows are single and double. A single row is placed against a wall. Double rows are placed back to back.

16. *Stack:* A self-supporting regular pile, two or more wide, one deep, two or more high. A stack may be either *cubical* or *pyramidal.*



Front view Side view

Cubical stack of 10



Front view Side view

Pyramidal stack of 10

17. *Standard-Sample:* An article always retained in the issue-bin or rack. The standard-sample should carry a tag bearing the stock number and the catalogue nomenclature of the article, and should never be issued except by written authority of the supply

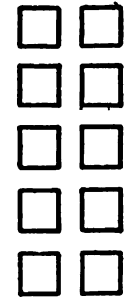
officer. New standard-samples should be substituted for old ones when required.

18. *Stowing:* The putting away of things, usually stores, in their proper places according to proper method. As the subject of this memorandum, it covers the larger ground of removal and general rules for handling.

19. *Tier:* Any one separate part of a column, or a horizontal row of a stack. Tiers are numbered in the order of their stowing—from the bottom up.

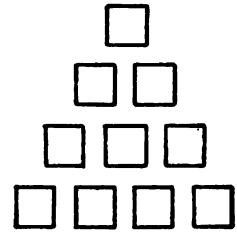
Front view

5 tiers of 1 each in a column



Front view

5 tiers of 2 each in a cubical stack



Front view

4 tiers of 4, 3, 2, and 1 respectively in a pyramidal stack

20. *Unit:* A quantity easily handled or normally issued at one time: *e.g.*, Wholesale—*1 case*, 24 in case, canned corn, No. 2 size can, xyz brand. Retail—*1 can*, canned corn, No. 2 size can, xyz brand.

FUNDAMENTALS

"A place for everything, and everything *properly* in place."

1. *Accessibility* of items, lots, and units, without rehandling. This means: (*a*) Goods will be stowed in issuable units. (*b*) Each item (and each lot where practicable) will be kept distinct. Therefore a unit of one item or lot will not be stowed on top of or in front of a unit of a different item or lot. (*c*) Goods will be placed so that the greatest number of individual units or packages will show. This facilitates counting, as well as accessibility.

Issuable Units.—The immediate accessibility of each lot of every item only emphasizes in a different way the fundamental general purpose of stowing, namely, to get at what you want when you want it with the minimum expenditure of time and effort. This means that goods should be stowed as nearly as possible in the units in which they will be issued, even though this requires the breaking of the units in which they are received. This is based on the fact that the time element required for unpacking is less important when the goods are first received than when they are called for issue. As a precaution against unnecessary loss from depreciation, it is obvious that the stock should be kept moving by always using the old lots first.

2. *Flexibility in Arrangement.*—This is secured by having storage spaces rectangular, and in area whole multiples of a standard rectangular unit. Bins, platforms, and floor spaces will then be interchangeable.

Unit Storage Spaces.—In few live organizations are conditions the same year after year; in some, the conditions change materially season by season. Hence the importance of flexibility in the arrangement and use of storage equipment. The determination, even at some effort, of a standard rectangular storage unit as the basis for the lay-out of the stores plant is a great help in obtaining this flexibility. Bins, platforms and floor spaces can then be made to correspond to this unit and so be interchangeable. Thus, without affecting in any way the general plan and lay-out, the particular equipment in use may be shifted to meet varying conditions.

Bin Subdivisions.—The same principle applies to the subdivision of bins and will lead to the adoption of a standard unit bin of such inside dimensions that it will hold the greatest variety of

standard removable subdivisions. A bin 20 by 14 by 14 inches inside, opening on the first two dimensions, has been proved satisfactory for a large proportion of naval supplies.

Emergency Bins.—For emergency use, bins may be improvised by stacking empty packing cases of uniform size back to back. Such double rows should preferably run at right angles to the long side of the building.

3. *Identification*, clear and complete, of every item, which means: *(a)* a tag for each lot; *(b)* a label on each unit or package, preferably on the end.

Symbols.—The clear and complete identification of each item is equally important. The same item must not be called by different names at different times; furthermore, the name of each item must be so distinctive that it cannot be confused with any other. This leads in many cases to the careful classification and symbolization of all items in stores. The symbol, being short, distinct, and standing for only one thing, is a convenient means for the accurate identification of stores.

Marks Face Out.—Identification marks on packages should preferably face out, or be conspicuous. Therefore the end of the package is usually the best place so that when stacked the largest number of labels will show, and furnish a check against packages being misplaced. This is especially important where goods are not tagged. The labeling of individual packages is not so necessary when lots are systematically tagged and placed in definite locations indicated by symbol both on the identification tag and on the balance records.

4. *Location* of an item governed by: *(a)* difficulty of handling; *(b)* quantity to be carried; *(c)* frequency of use; *(d)* special considerations, as of sensitiveness, perishability or peculiar similarity to other items; *(e)* safety (floor strength, fire hazard).

General Considerations.—The elements determining the location of an item are sometimes conflicting. Of course, a large, heavy item, difficult to handle, should be given the shortest possible haul. Similarly, an item easy to handle but carried in large quantities and very frequently used, should be in a convenient location with short haul. The same is true of items which, when issued, have to be specially measured, such as bar-stock, or sirup in barrels.

Special Considerations.—There may be, of course, special considerations such as the sensitiveness of explosives, the perishability of meat or other foodstuff, or peculiar similarity, such as of pipe and

bar-stock which would clearly point to the necessity of stowing those items together. Whether the location under those circumstances is most convenient is generally secondary to the particular equipment necessary for their proper care. It is sometimes found economical to stow near each other special parts or articles of equipment which are regularly issued together in a group. It is also desirable to keep unserviceable articles separated from serviceable.

Safety.—The stresses which floors will stand must of course be known and allowed for. Whether fire-passages (of 2 feet) along all walls should be left, depends on local conditions and the nature of the goods. In general, fire-passages are more necessary with block piling, or where stacks run parallel to and adjoin the walls. Fire-passages are less necessary when stacks, with side aisles between every two, run at right angles to walls. In the latter case, the side aisles give direct access to wall space every few feet, and packages next the wall in any given stack may be easily and quickly removed.

5. *Methods*, defined in written instructions, of *placing and removing* various classes of items.

a. Uniformity—always piling the same item the same way, and in such a way that each full column, stack or block will contain the same quantity as each other full column, stack or block.

b. Distinct separation of each lot, so that old lot may be used first.

In Writing.—The importance of establishing in writing some defined methods of placing and removing the various classes of items need not be emphasized. The very effort to determine the methods forces attention and decision for the time being, at least, on the one best way under the circumstances. More than that, it is true that the consistent following of even a poor standard brings better results than the haphazard and uncertain following of the best of standards. The more completely a poor rule is followed, the more clearly will its failings be revealed and the better can it be revised.

Neatness; Exceptions Conspicuous.—Standard methods for piling each class of goods will insure neatness and uniformity. Then the exceptions to good piling, by their very conspicuousness, will be their own signal for correction. "Publicity is a potent factor in keeping things right." Therefore, unnecessary covers, doors, and other protections, behind which wrong practice may be concealed, should be avoided.

More Accurate Inspection and Count.—Besides leading to precision in handling and making carelessness more noticeable, such uniformity greatly facilitates the accuracy and speed of inspection and count. So far as possible, stores should indicate their own count. Hence the importance of uniformly regular columns, stacks, and blocks. This is the chief reason for preferring cubical to pyramidal piling. The quantity in a full pyramid may be calculated by mathematical formula but difficulties are apt to arise as soon as part of the pyramid is removed. "How much is left" is an all-important question and it should not be necessary to count each article to find out. Piling in uniformly regular columns, stacks, and blocks, with only one last block, stack, column or package containing an odd quantity, is the simple solution of this problem.

Decimal Units.—For the same reason, the use of easily calculated decimal units for the quantities in blocks, stacks, columns, and sometimes packages, is desirable. The instruction specifying that piling may be done in single units up to 10 and after that only in multiples of 5 illustrates the point.

Double Space.—The allotment to each regularly carried item of double the space needed for each regular lot of the item received is, where sufficient space is available, well worth while. It insures accuracy and simplicity in handling the different lots, each being kept separate and the old lot always being used first. It also results in less frequent need of locating parts of the same item in different places. Where only the single space required for a lot is reserved for it, and a new lot comes before the old lot is used up, it is often necessary to put part, if not all, of the new lot somewhere else, there being no room for it in the space with the old lot. This process, repeated often enough, leads to a constant shifting of the location of given items and results in confusion. In some cases where the storekeeper is responsible for the quantities on hand, he loses sight of some portions of an item and calls for more before he really needs it. This means unnecessary investment and the added liability to loss from spoilage. Some plants have found that the cost of the double-space system suggested above was well repaid by protection against such loss. The less intelligent and skilled the help, the greater is the usefulness of the double space system. It is more nearly "fool-proof."

6. *Planning* new areas.
   - *a.* The listing and classification of all items according to:
     1. Measurements.
     2. Difficulty of handling.
     3. Frequency of use.
     4. Special considerations, as of sensitiveness, perishability or of peculiar similarity.
     5. Quantities to be carried.
   - *b.* Determination of proper unit storage space.
   - *c.* Determination of proper aisle spaces.
   - *d.* Determination of proper lay-out of storage and aisle space with general location of items and calculation of total space needed.
   - *e.* Lastly, the planning of structures so that entrances, aisles, posts, platforms, windows, and other necessary features will not interfere with but will facilitate the most desirable lay-out of the stores themselves.

The importance of accomplishing the most with every man-hour of labor as well as every dollar of expense is the measure of the importance of careful stowing. Hours of labor and dollars of expense can be avoided by intelligent planning ahead. The storekeeper must predetermine and control his results instead of letting conditions take him by surprise and find him unprepared. Where he has the planning of new storage areas he will find it pays, for best results and a minimum waste of space and operating expense, to observe the sequence above.

7. *Spaces*, preferably marked, reserved exclusively for
   - *a.* Moving.
     Aisles should preferably be straight, and only wide enough for actual requirements.
   - *b.* Stowing.
   - *c.* Receiving.
     When necessary to hold material awaiting disposition.
   - *d.* Assembling.
     When necessary to hold material awaiting delivery.
   - *e.* Shipping.
     When necessary to hold material awaiting shipment.

Aisles Must Be Kept Clear.—The real reason for taking pains that stowing of stores shall be orderly and systematic is to be able to

get at what is wanted when it is wanted, with the least possible expenditure of time and effort. This involves having what you want on hand in sufficient quantities and knowing where it is. The only way of getting at what is wanted is by means of the aisles and passageways provided for the purpose. It is axiomatic, therefore, that the aisles should be of only such width as is required for the necessary passing and handling of the goods to be stored. It is equally fundamental that they cannot be obstructed by things left standing in them or by the projection of things stored along their margins. The delay caused by unexpectedly encountering a blocked aisle is always wasteful,—likewise, the danger of damage to goods projecting from the proper bounds of either storage spaces or conveyors is obvious.

Aisle Widths.—Aisles should be planned according to their use and the size of conveyors or materials to be handled in them. Main aisles for two-way passing of trucks may need to be six or eight feet, or even more in width, according to conditions. Side, connecting aisles, or those straight through the building, for one-way passing, need be only comfortably wider than the trucks to pass through. Blind side aisles, ending in a wall, if for trucking, normally should be wide enough to allow the truck to turn around safely. This is especially true where four wheel or elevating platform trucks are to be used. Thirty inches is a standard width for aisles between bins or shelves where the contents are package goods carried by hand.

Boundary Lines.—Showing the boundary lines of aisles and likewise of storage, receiving, assembling, and shipping places is important in order that there may be no vagueness about the limits of the spaces required for each. The more permanent and conspicuous these boundary lines are made, the better. In buildings, lines two inches wide of black or red paint, or of strips of zinc tacked to the floor, have been used effectively. The right amount of space in a well planned stores layout is essential. More than this amount is wasteful, whereas less than this amount for each particular purpose leads inevitably to congestion, and congestion must be avoided.

INSTRUCTIONS

Stowing.—1. *Counting.*—All goods will be counted before or during stowing, and the quantity entered on the tag.

2. *Storage Space.*—Stores are stowed only in the spaces reserved for the purpose. This means that window sills, ledges, floors, aisle

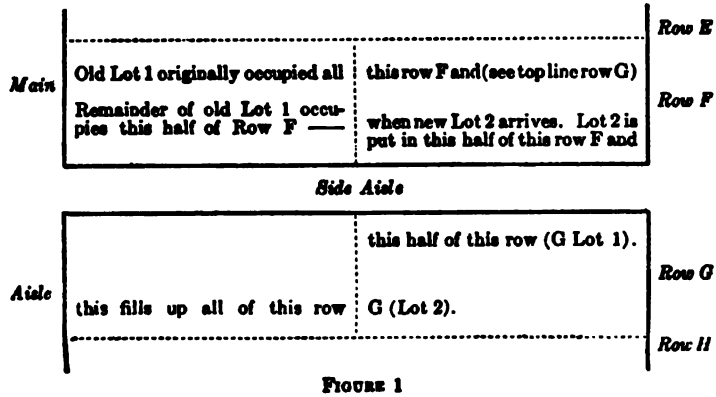


FIGURE 1

spaces, etc., are not to be used either permanently or temporarily for keeping goods unless the tag on the goods bears the signature of the

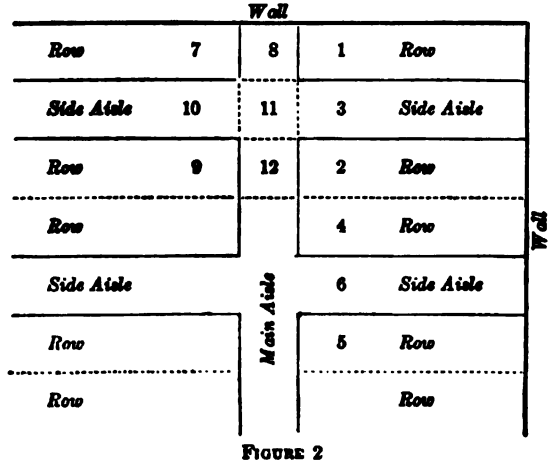


FIGURE 2

proper official authorizing the use of such space for that purpose. Tools or equipment in regular use in store rooms will be provided

with special places, marked so as to show the purpose for which reserved.

3. *Space for One Item.*—The space allotted to any one item will be enough to hold the maximum expected on hand at one time, with each lot distinct. If the normal lot would occupy 1½ rows, and usually arrives when one-third of the previous lot (or ½ row) is left, the total space reserved for the item would be 2 rows. (See Fig. 1, p. 314.)

4. *Placing.*—The placing of any item of stores depends on the shape and character of the article, and the nature of the storage place. On the floor are placed cases of such size and weight as would be apt to break a platform in handling. All other stores except those stowed in bins or on racks are placed on platforms. These are largely goods of bulk and weight, such as sometimes require more than one man to handle and pile (*e.g.*, barrels, bags, bales, bundles, and ordinary cases and crates). Small stores, such as those in small boxes, cartons, and packages, and loose supplies are put in bins. Articles of unwieldy length, like iron piping, are placed on racks.

5. *Accessibility.*—Goods will be placed so as to be as easily accessible as possible, those more frequently used being in the handier locations.

6. *Minimum Handling.*—Consistent with the above, they will be placed so as to require as little handling as possible in receiving, stowing and removing. Old lots should not have to be disturbed when new lots are placed. Other things being equal, heavy bulky goods will have the shortest haul.

7. *Rows.*—In stowing a bulky item of stores in quantity, effort will be made to concentrate it. Thus two rows opposite each other (across a side aisle) will be filled in preference to two adjacent rows. Any excess over two rows full may then be stowed in the aisle between. This saves space to almost the extent of solid block piling, yet preserves the desirably flexible row arrangement with its maximum of direct accessibility.

8. *Side Aisles.*—Side aisles may be used for stowing only when the rows on either side are full of the same material.

9. *Main Aisles.*—Main aisle space adjoining a wall may be filled out to parallel full rows and aisles of the same material on either side. Platforms will, when practicable, be placed for goods stowed in aisles.

Figure 2, page 314, illustrates the order in which rows and aisles may be filled with a large lot of one item. Removals will be in reverse order. See paragraph 3, page 320, under "Removing."

10. *Spoilage.*—Articles should never be stowed in a position which might cause injury to them. Thus sheets of unprinted paper should lie flat and brooms should stand on handle end, or hang. Likewise, placing articles so they project from the edge of a bin or platform is to be avoided. In general, articles will be kept off the floor or the ground. In placing items subject to deterioration from heat and dryness or from cold and dampness, it will be remembered that air near the ceiling is usually warmer and dryer than near the floor.

11. *Height.*—In stowing goods, the greatest economy of space is secured by tiering in cubical stacks and blocks as high as is consistent with stability, thus leaving a maximum area for different groups and kinds of articles. Where economy of space is not critical, economy of time and effort are more important, and goods will be tiered only as high as an ordinary man can reach. Five feet to the top of the next to last tier is a normal height for packages not exceeding 100 lbs. As far as possible men should work singly, rather than in groups.

12. *Shape; Cubical versus Pyramidal.*—Where it is possible to choose between cubical and pyramidal piling of goods, the cubical method will be given preference.

Advantages of cubical piling:

1. More economical in use of space.
2. Easier to keep uniform and regular.
3. Easier to inspect.
4. Easier to count.
5. Less spoilage from weather, if uncovered.

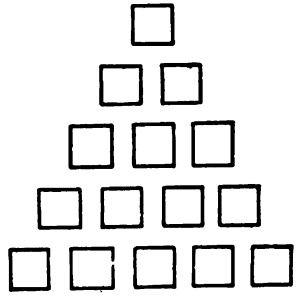
Advantages of pyramidal piling:

1. Simpler and easier to secure stable tiering of cylindrical or other rolling articles, such as shells, by bracing the bottom tier only of each stack. Cubical tiering of such goods requires bracing the stack all the way up.

2. Easier to cover from weather, because of its shape like a peaked roof.

Where pyramidal piling is a necessity,
No. in full stack =

$$\frac{\text{No. on bottom tier} \times (\text{No. of tiers} + 1)}{2}$$



For a full pyramidal stack with 5 in bottom tier

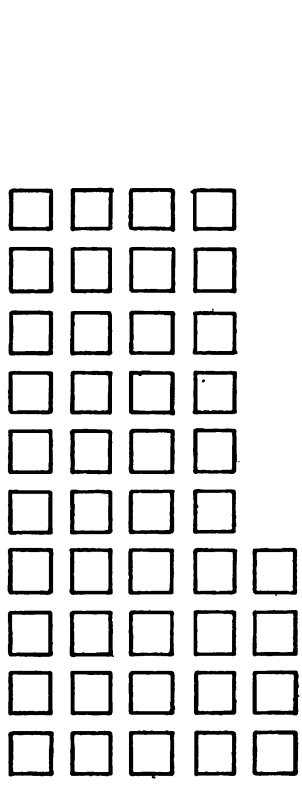
$$\text{No. in stack} = \frac{5\times(5+1)}{2} = \frac{5\times6}{2} = \frac{30}{2} = 15$$

The number in any block, whether pyramidal or cubical, will be the number in one full stack times the number of full stacks in the block.

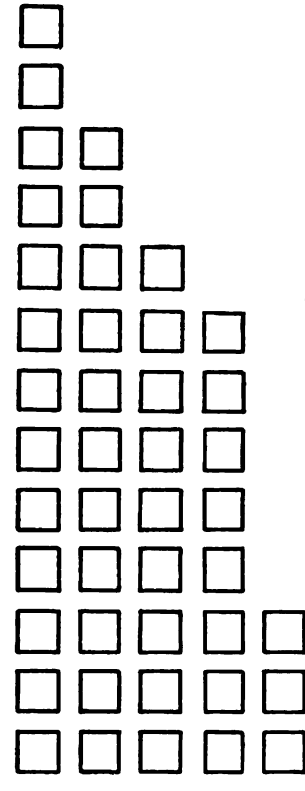
13. *Uniformity.*—Full columns, stacks or blocks of any one item will be kept uniform for that item. Only the last column, stack or block may remain incomplete, containing odd quantities. This will add both to neatness, and to ease and accuracy in counting.

14. *Group Piling.*—Stores are piled singly or in multiples of five. Goods may be piled singly up to ten in a column. Beyond this the columns are made as high as the space will permit but of whole groups of five only. Groups are not broken to fill in a remaining space too small for a whole group. Thus every column of articles small enough to be piled in groups of five will contain some multiple of five and will be uniform for that article. For instance, if a bin holds 24 packages of letterheads piled snug to the top, the column will be made of 20 packages only, viz., 4 groups of 5 each.

15. *Stowing Area.*—In any area to be filled, such as a platform unit, stowing is commenced at the back left-hand corner, and brought forward, each row of goods being completed to the front before a new row is started. Tiering is done as soon as the nature of the



Correct method of piling 44 in 1 stack (front view)



Incorrect method of piling 44 in 1 stack (front view)

goods permits and as high as possible so long as the stacks are stable, the uniform groups are preserved, and the stack does not come too near the ceiling. Space will be left for the proper working of the sprinkler pipes, and for properly removing (such as by upending) the goods on the top tier.

16. *Stowing Volume.*—In any cubic space to be filled, such as a bin, stowing is commenced at the back left-hand corner, and carried on vertically until one column is completed. This is made the first of a row of such columns brought to the front and completed. The second row or columns will commence, as did the first, in the farthest left-hand corner of the remaining available space, and be built up and forward in the same manner.

17. *Separation of Lots.*—Different items or different lots of the same item will be kept distinct. If placed in the same storage space, they will be separated by a space of at least one inch if in bins, or three inches if on platforms. Each lot of each item has its own separate tag and lot number.

18. *Direction.*—Goods will be placed all one way unless for stability it is necessary to reverse or cross-pile. *Reversing* will be done singly or in groups, according as the goods are piled singly or in groups, the same dimensions, however, lying the same way. *Cross-piling*, or laying goods in each tier or course at right angles to those just below, while increasing stability, decreases accessibility and sureness of count. As stability is generally less vital than accessibility and flexibility, cross-piling will be resorted to only in special cases. Where ventilation is required, as in piling lumber, cross-bars separating each course will be used. Thus the goods in all the courses may still lie all one way. The best way in general for goods to lie is with their ends out towards the aisle into which they will be withdrawn. If, however, space is economized to a marked degree (at least 25 per cent) by placing the goods in some other way, it may be done.

19. *Labels.*—Labels, or other means of identification, will be placed all one way, showing outward if consistent with other rules.

20. *Wrappings.*—Articles with defective wrapping will be placed last, in order that they may be removed first. The person stowing goods is responsible for seeing that the tying or wrapping on packages is in as good condition as his facilities enable him to secure. This includes the putting on of new wrappings when necessary and feasible.

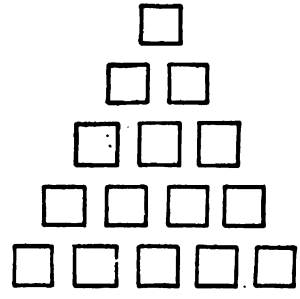
21. *Maximum.*—The maximum quantity ordinarily stowed will occupy not more than 75 per cent of the space available. The remaining space is reserved for times of special need.

Removing.—1. *Parts of One Lot.*—In removing goods from storage, in any one lot the last goods to be put in place are removed first, and further removals are made in just the reverse order to that in which they were placed. This means the cleaning up of incomplete before complete columns, stacks and blocks are touched.

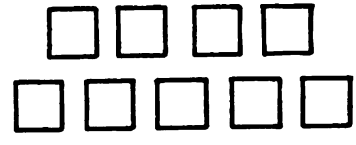
2. *More than One Lot.*—In the case of more than one lot of any one item, the lots are drawn from in order of age commencing with the oldest, unless otherwise specified on the issue. Not until all the goods of one lot are removed from any part of a storage space and the tag removed, is that part available for stowing a new lot.

3. *Goods Concentrated in Aisles.*—Where goods have been concentrated by stowage in side aisles between regular storage rows (see paragraphs 7-9 under "Stowing"), removals will be made first from aisle spaces. No goods will be removed from a regular row until adjoining aisle spaces have been entirely cleared.

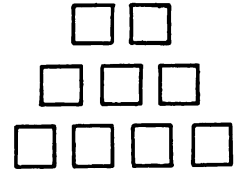
4. *Pyramidal Blocks.*—Removals from a pyramidal block will not be from the side slopes or from along the top, but will be stack by stack from the front. Thus there will be not more than one incomplete stack at any one time, all stacks behind the front one being complete. Removals from any one stack will be tier by tier from the top, so as not to disturb existing stability, or any braces at the bottom tier.



Full Stack of 15



Correct removal of 6, leaving 9



Incorrect removal of 6, leaving 9

WAREHOUSING OF MERCHANDISE [1]

To the general merchandise subdivision of the American Warehousemen's Association:

GENTLEMEN: In the performance of the duties assigned to your Committee [2] they have followed the principle laid down in the 1918 Report, that their work should be strictly confined to preparing a standardized basis for rates from which the individual warehouseman could compute rates that would be equitable as between different commodities in his warehouse; rates that would produce the same net revenue from each and every class of goods whether stored in bulk or in assortment, in quantity or in small lots. They have assumed that not only was it no part of their duty to attempt to produce uniformity of price as between different warehouses, but that it was imperative they do nothing that would indicate or suggest a combination to establish such uniformity; to do so, whether or not it could be construed as a combination in restraint of trade, would be directly contrary to the evident intent with which they were appointed.

It has appeared to the Committee that in view of the increase in cost, both of construction and operation, the growing demand for services other than simple storage and handling, and the great advances we have made in our knowledge and understanding of warehouse expenses, customs and economics, their first and most pressing duty was to revise and bring up to date the 1918 Report. Valuable as that report was when made, it is already out of date and almost obsolete and in the present report they have endeavored to make it as of September, 1920.

The theory of the back piling of goods in assortment has been abandoned for the reason that the vast majority of building laws and regulations do not permit overloading any floor space to counterbalance underload or vacancy on adjoining space.

The car-lot and assortment system has been replaced by the lot-unit system for the reason that existing railroad classifications are found to be inequitable and indefensible when applied to goods in

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[1] Report of the Central Bureau Committee, General Merchandise Subdivision, American Warehousemen's Association, 1920.

[2] The committee was composed of the following: T. E. Witters, chairman, Baltimore, Md.; John Bekins, vice-chairman, Omaha, Neb.; C. W. Macdonald, Chicago, Ill.; Edwin Morton, New York, N. Y.; S. G. Spear, Boston, Mass.; George Hamley, Minneapolis, Minn.; S. H. Verrall, Chicago, Ill.; D. L. Tilly, New York, N. Y.; E. H. Bacon, Louisville, Ky.; R. W. Dietrich, New Orleans, La.

warehouse, and several other minor changes have been made for similar reasons.

Your Committee realize that this report will appear complicated to a novice in warehousing, but that is inevitable. Just as an engineer requires a knowledge of mathematics, a lawyer a knowledge of law, a banker a knowledge of finance, so a warehouseman requires a knowledge of the fundamental principles of his business, and none of these may be acquired without study. There is no royal road to learning; no warehousemen's guide can be prepared that would enable a neophyte to become a warehouseman without preparation, experience and study, and as Mr. Dooley says, "'tis better so." This report is of value only to those warehousemen who "want to know" and are willing to work for knowledge. Your Committee have worked long and hard to prepare it, but their labor will have been in vain unless you are willing to master and apply the results so far as they are directly applicable to your particular business, and to continue to modify them as your individual needs may require.

There have been five meetings of the Committee during the year, at Atlantic City, February 2, 3, and 4; at Pittsburgh, May 17, 18, and 19; at Minneapolis, July 13, 14, and 15; at Louisville, October 4, 5, 6, and 7; and at Boston, October 20 and 21; also numerous meetings of subcommittees and conferences of individual members. Messrs. Jacobson of the New York Bureau, Carruth of the Massachusetts Association, and Criss of the Central Bureau sat with the Committee at every meeting and rendered invaluable assistance, and the General Bureau Committee has been represented at every meeting by its chairman and one or more other members.

EXPLANATION OF TERMS

Standard pile is a pile containing the greatest quantity of a commodity that can be practically stored in bulk, not exceeding $8^1/_3$ feet high nor 250 pounds per square foot of floor space occupied.

Lot unit (L. U.) is the quantity of a commodity contained in a standard pile covering 120 square feet.

Height of standard pile is the theoretical height of the standard pile as computed from the gross weight per cubic foot of the commodity in pile. When it is not practical to pile as high as the theoretical point indicates, then the practical height is substituted.

Floor load is the weight of a pile of goods per square foot of floor space occupied.

Index is the number of square feet of floor space occupied by a package in pile when stored to the maximum practical pile height (not exceeding $8^1/_3$ feet), weight not considered.

Density is the weight per cubic foot of a commodity.

Assortment is the term used to describe a lot of goods containing more than one mark, brand or sign to be stored and accounted for separately.

Pile space is the floor space actually occupied by a pile of goods exclusive of entrance aisles made necessary by assortment or individual package delivery.

Available space is the total floor space inside of walls after deducting elevators, stairways, office, shipping, and laborers' room.

Occupiable space is the available space less main, or permanent, aisles and columns.

Gross space is based on outside measurement of building and includes space occupied by walls.

Honeycomb is the state, or condition, of a pile when partial delivery has reduced the number of packages in pile without proportionately reducing the floor space occupied.

Individual package delivery, sometimes called "Serial Number Delivery," is assortment carried to its extreme, wherein every package must be stored and accounted for separately.

Base class is computed on not less than a lot unit of one mark, brand, or size to be stored and accounted for separately.

Productive labor cost is the wage cost of laborers and checkers while actually engaged in an operation for which a charge is made.

STANDARD WAREHOUSE RULES AND REGULATIONS

1. *Packages.*—The warehouse undertakes to store and deliver goods only in the original packages in which they are received.

2. *Tender for Storage.*—All goods for storage are to be delivered at the warehouse properly marked and packed for handling, and the storer shall furnish at or prior to such delivery a manifest showing marks, brands or sizes to be kept and accounted for separately. Otherwise the goods will be stored in bulk or lots at the discretion of the warehouse and will be billed accordingly.

3. *Warehouse Receipts.*—A warehouse receipt will be issued on each lot of goods stored. No charge will be made for the issuance of non-negotiable receipts.

4. *Storage Periods.*—Unless otherwise provided, all commodities are stored on month-to-month contracts, and the warehouse reserves

the right to require the removal of any goods within thirty days from next storage date. Only such notice as is reasonable or possible under the circumstances is required on perishable or hazardous goods.

5. *Storage Rates and Expiration.*—Storage rates cover warehouse space required for one month or fraction thereof, dating from receipt of the first package, and are charged in advance from that date up to but not including same date of the following month. When the final expiring date falls on a Sunday or legal holiday, the next business day shall be deemed the expiring day.

6. *Transfers New Contract.*—When goods in storage are transferred on the books of the warehouse from one party to another, a new contract is made thereby and a new storage date established on the date of such transfer.

7. *Bonded Stores.*—Due to the extra expense of operating bonded warehouses, an extra charge over regular storage, handling and other rates will be made for bonded merchandise.

8. *Insurance.*—Storage rates do not include insurance of any kind and insurance rates, if quoted, are not guaranteed.

9. *Limited Liability.*—Liability of the warehouse for loss of or damage to goods stored shall in no case exceed eight dollars ($8) per cubic foot or twenty-five (25) cents per pound, according as weight or size determines the rate, unless excess value is declared by the customer at the time the goods are stored. A charge will be made for such excess value.

10. *Responsibility of Warehouse.*—The responsibility of the warehouse is defined by the laws of the State.

All goods are stored at owner's risk of loss or damage by civil or military authority, or insurrection, riot, strikes, enemies of the government, sprinkler leakage, flood, wind, storm, fire, moth, corruption, depredation of rats, mice, or vermin, change of temperature, or by any cause beyond the control of the warehouse.

The warehouse will assume no responsibility for concealed damage, leakage of liquids, or for losses in weight by reason of defective or insufficient containers whether occurring when goods are on storage or are being handled, nor for failure to detect or remedy the same.

All storage, handling or other charges must be paid on goods lost, damaged or destroyed.

11. *Access to Goods.*—Customers, their representatives or workmen will not be allowed to have access to or work on goods in store unless accompanied by a warehouse employee, for whose time a charge will be made.

12. *Delivery Orders.*—Orders signed in full and in writing will

be required for the delivery of all goods, and this reasonable precaution shall be taken by the owner in order that the warehouse may know definitely the goods desired and make proper delivery.

13. *Excess Deliveries.*—A charge will be made for an excessive number of deliveries from any one lot.

14. *Time for Effecting Delivery.*—When goods in store are ordered out, a reasonable time shall be given the warehouse to execute the order. Inability to effect delivery before expiring storage dates shall not prevent assessing the storage charge for another month.

15. *Handling.*—Handling charges cover only the ordinary labor and duties incidental to receiving goods at warehouse door, stowing and delivering at warehouse door, and do not include loading or unloading cars, trucks, or other vehicles. Handling charges will be billed with the storage charge for the first month.

16. *Unloading Cars.*—Charges for unloading cars include the use of tracks, platforms, etc., and the labor of unloading.

17. *Loading Cars.*—Charges for loading cars cover the use of tracks, platforms, etc., and the labor of loading cars.

18. *Demurrage.*—Demurrage will not be absorbed by the warehouse, but diligence will be used to load or unload cars promptly.

19. *Distribution.*—Distribution charges cover the checking out and delivery of goods at car within the time specified by the warehouse. Previous to the unloading, notice shall be given stating the number of packages wanted, brands, sizes, etc., and to whom they are to be delivered. The charge for distribution is additional to the car unloading.

20. *Drayage.*—Drayage charges cover ordinary cartage of goods and delivery at platform or sidewalk. When delivery is required in basement or on upper floors or other inconvenient places, an extra charge will be made.

21. *Shipping.*—Shipping charges cover billing, marking or tagging, procuring bills of lading and mailing same. A separate charge will be made for each express or parcel post shipment.

22. *Furnishing Space, Light, Tools, etc.*—Whenever warehouse space, light, power, tools, or material of any sort are supplied or loaned by the warehouse, a charge will be made therefor.

23. *Weighing, Sampling, Coopering, etc.*—A charge will be made for weighing, sampling, coopering and other miscellaneous services when performed by the warehouse.

24. *Extra Labor.*—Charges will be assessed for extra labor furnished by the warehouse, whether common, skilled, or clerical.

25. *Taking Down, Repiling, etc.*—When goods are taken down and repiled in store for weigher or other convenience of customer, the handling charge of receiving and delivering will be applied.

26. *Collections.*—A charge will be made for making collections for customers.

27. *Cash Items Advanced.*—Freight and other cash items advanced become a lien on the goods stored, and are payable on demand. A charge for this service will be made. Deliveries or transfers from such lots will not be made until lien is satisfied.

28. *Stock Statements.*—Stock statements submitted in duplicate by customer will be checked with the books of the warehouse without charge.

A charge will be made for warehouse checking or stock taking.

29. *Gross Weights.*—When rates are quoted by weight, they will be computed on the gross weight.

30. *Ton.*—The term "ton" when used means two thousand (2,000) pounds.

31. *Minimum Charges.*—Minimum ratings will be applied on storage, handling or other service charges.

32. *Postage.*—Postage and addressed envelopes must be furnished by customers requiring notification of shipments or deliveries and reports.

33. *Charges Due.*—All charges become due when billed.

34. *Labor Disputes, Strikes, etc.*—The warehouse will not be responsible for delays in receiving or delivering merchandise by reason of labor disputes, strikes, or any other causes beyond the control of the warehouse.

35. *State Laws.*—Nothing herein contained shall be deemed a waiver or modification of the rights of the warehouse under the laws of the State.

STANDARD BASIS FOR CLASSIFICATION OF GOODS FOR STORAGE

The infinite variety of packages offered for storage, varying in weight from ten to three thousand pounds, in size from one-half to one hundred and fifty cubic feet, and in shape from perfect symmetry to the irregularity of an uncrated piece of machinery; the wide variation in the nature of the commodities and the consequent different requirements as to care, location, and handling, and the great difference in value, all combine to make classification a complicated and difficult task. We believe, however, practically all of

the goods offered for storage can be properly classified, and in a manner that is comparatively simple for the operating force.

It is all-important that the factors used in any classification shall rest on a defensible foundation, and serious consideration has been given to the work along this line, particularly to the questions of height of pile and floor load, and laws relative to use and occupancy when once these two points are fixed. Certainly no classification could be of value that did not comply with the law and the insurance regulations.

The basis of this classification for storage is the greatest commodity quantity that can be practically stored in bulk on 120 square feet of floor space not exceeding 250 pounds per square foot or $8^1/_2$ feet high.

Less than Full Lot Unit Quantity.—The demand for service of various kinds makes it necessary to provide a segregation of the quantity adopted for the base classification, and here we are confronted with the complicating factors of assortment, decreased piling height due to instability of pile in small unit, excessive honeycomb, excessive delivery costs, etc.

It is no longer a theory but a fact, that a serious matter confronts the industry with the changed character of the business offered warehousemen in recent years, enhancing costs very materially and adding much to the warehouseman's responsibility.

Statistical data are fundamental and although cost accountants have recently revealed many facts on costs of specific services pertaining to storing and handling goods, particularly in small units, yet it is practically impossible to combine the known facts in a formula that will in all cases do justice to storer and warehouseman alike without an excessive amount of special charges, complicating the rating system and not desired by either party.

In view of this present and ever-increasing demand for service it is manifestly unjust to apply to all receipts the average cost of storing or handling a commodity under all conditions, and the result of such practice must be obvious to all thinking warehousemen.

The situation demands that warehousemen meet this condition in some practical way, and after due consideration of all information available it seems best to assume that the storer who elects to store his goods in small units is dealing with the warehouseman in a retail way and therefore should bear the burden, an assumption that may or may not be true in specific cases but nevertheless is representative of the trend of costs and a recognized principle in commercial activity.

The above conclusion is reached on the further assumption that

each car of goods received shall be computed on its own basis and as such the sorting would be included in the rate. If, however, the shipment consists of more than one car, each containing assortment but to be accumulated for storage in full lot unit quantities or more, the warehouseman would be entitled to extra reimbursement for the extra service involved.

Individual Package Delivery.—Although individual package delivery is "less than lot unit" carried to its extreme and differs therefrom only in degree, it requires somewhat different consideration. In L. L. U. a percentage is used that is assumed to represent the average waste of space due to aisles and honeycomb in the various sizes of lot. A lot of less than five packages is rare and the percentages are estimated on a much higher average; in I. P. D. the lot is one package. Thirty-three and one-third per cent aisles are generally sufficient, but in the case of small packages a wider aisle may be required to admit a man or a truck. This also occurs in the case of irregular-sized packages, such as case goods or dry goods, the aisle having to admit the maximum package.

Height of pile is also limited to a point lower than that indicated in L. L. U. owing to the increased instability of pile and excessive cost of delivery of packages in the lower tiers. Experience demonstrates that four packages high is an extreme limit; that two high is the height most often indicated; and that one high is much more frequent than anything over two.

Small Packages.—Theoretically, small packages of a commodity can be stored at proportionate rates per hundredweight to that of the larger packages of the same commodity, but this does not appear to work out under practical operating conditions. In many cases the instability of the pile when partial delivery of the lot takes place necessitates the removal of goods in the upper tiers to a lower level; fragility of package oftentimes will not permit of rehandling broken lots for the purpose of making space for other goods, and the excessive cost of rehandling all tend towards excessive honeycomb of the house. The absence of statistics to indicate the extent of this loss makes it necessary to accept some arbitrary figure in the computation of the rate. Furthermore, it seems advisable to fix a minimum charge on small packages regardless of weight. This increased charge may be avoided if the manufacturer will pack or strap small units into one larger unit for which he will receive a lower rating per 100 pounds than he would otherwise obtain.

(See full text of "Report of the Central Bureau Committee—American Warehousemen's Association, 1920.")

AVERAGE OCCUPANCY OF WAREHOUSE SPACE

The total available space as defined on page 323 is the basis of all computations and estimates. A portion of this space is necessarily permanently unoccupied, and this has been divided into two classes —aisle space and working space. Another portion is sometimes occupied and sometimes unoccupied, and this has also been divided into two classes—waste space and idle space. All of these classes will vary in different warehouses and with different lines of business and the last one will vary as between different seasons or years.

Aisle Space.—The permanent aisles required for the economical handling of goods from door to pile and from pile to door, or required by the fire regulations to furnish access for firemen, are estimated at from 20 per cent to 25 per cent. No warehouses were found where the actual figure was less than this estimate, and while there are many where it must be more, it was not thought proper to take into consideration a manifestly badly designed or poorly laid-out warehouse or an unsuitable building used for warehouse purposes.

Working Space.—It is well known to all warehousemen that some vacant space is necessary at all times, or practically all times, to provide for regular customers; to furnish room for weighing, inspection, or examination, sampling, rehandling of any kind, and to take care of unexpected demands for space. No warehouse can hold its customers long unless it constantly, or at least generally, has on hand some stock of the only line it has to sell, namely, space for the storage of merchandise. How long can a merchant hold his trade without having any stock to fill an order? The necessary average of working space has been estimated at 5 per cent to 12 per cent, and this minimum is certainly conservative.

Waste Space.—The space left vacant by partial delivery of block or bulk lots and the space left vacant by failure of lots as received to fill entirely any space obtainable at the moment. This waste space is not to be readily estimated, but it is there just the same. Even unit lots of merchandise cannot be packed in a warehouse like toy building blocks in their box. Waste space is estimated at from 0 to 8 per cent, and again the minimum is manifestly low.

Idle Space.—It is well known that there come in our business dull years or seasons that show a surplus of vacant space and deficit of earnings that must be taken care of in good years. In 1913 and 1914, Massachusetts warehouses averaged less than 40 per cent capacity or 30 per cent available floor space occupied. Next to aisle space this is the largest item of unoccupied space and it is one that

cannot be avoided. The difference between the maximum and the minimum demand for storage is very great, and if warehouses as a whole are to be reasonably prepared to take care of the peak load they must necessarily average a considerable proportion of idle space. What that proportion is cannot be accurately determined, but an estimate between limits can be made. Those limits have been set at from 0 to 40 per cent. That maximum has undoubtedly been exceeded, but exceptional cases should not be considered in determining averages, and the maximum here used represents a not uncommon occurrence.

The result of these various estimates is:

Aisle space (including space occupied by columns)	20 to 25 per cent	
Working space	5 to 12 per cent	
Space permanently unoccupied		25 to 37 per cent
Waste space	0 to 8 per cent	
Idle space	0 to 40 per cent	
Space unoccupied at times		0 to 48 per cent
		25 to 85 per cent

In other words, the maximum and minimum percentages of occupancy are respectively 75 per cent and 15 per cent, the extremes of vacancy being 25 per cent and 85 per cent. The mathematical average is 45 per cent, but it has seemed to the Committee that good business management in a Standard Warehouse should produce a little better than that, and so the 50 per cent figure has been used.

In considering this it must not be forgotten that 50-per cent of available floor space occupied does not mean that the warehouse is only half full. It means that the warehouse is three-fifths to three-quarters full. From 25 per cent to 40 per cent of "available space," although it is "available" for business purposes, is not "occupiable" for goods on storage as it is necessary for aisles and working space. When a warehouseman has filled his occupiable space—from 60 per cent to 75 per cent of his available space—he is done, he is out of business for the time being, he can take no more business until after he has delivered something. That means that he must discommode old customers and decline new ones; his working force is idle though his pay roll is still active and his handling account is developing a balance on the wrong side.

The Committee believe that these estimates are conservative and that the conclusion is defensible.

HANDLING

The warehouse business has in many cases been very unprofitable in the past as a result of ignorant competition due to an absolute lack of knowledge of the cost of handling merchandise.

One of the most serious mistakes has been losing sight of the fact that there is a heavy overhead expense attached to handling operations. This oversight has practically made bankrupts of many warehouse concerns whose executives were experts on general problems and the handling of labor.

Unusual conditions, due largely to the war, have created an extraordinary demand for storage facilities. This has resulted in some warehouse concerns enjoying an era of prosperity who were in a rather precarious financial condition before the war. The demand for storage facilities caused many new warehouse concerns to enter the field. The inevitable reaction with its attendant period of competition requires careful consideration and demonstrates the need of every warehouseman in the country for a sound fundamental basis for complete knowledge of his own business.

The unscientific method commonly used for estimating handling costs was to determine the actual cost of the *in* movement of the goods; an arbitrary amount for delivery (varying all the way from 50 per cent to 150 per cent of the *in* cost) was added as an estimate of the probable delivery cost and the price was then quoted slightly, if any, higher than the resultant figure. Nothing was added for overhead expense, nor was consideration given to the various additional services furnished.

This method, when wages of warehouse labor averaged 20 cents per hour, made the handling rate appear to be about the same as the prevailing rate for storage. From this grew up the rough and ready idea of charging the same amount for handling as for one month's storage. Thus, the first month's charge would include the receiving and delivering of the merchandise and would be twice the charge for each succeeding month.

The actual result of following this method has been that some commodities were carrying the burden for others, or in other words some commodities were paying an excessive rate of profit, while others were handled at an actual loss; obviously the warehouseman would be far better off were he to discontinue accepting for storage

the latter class of merchandise, if increased rates could not be obtained. By the same reasoning, when he determines the line of merchandise which pays the excessive profit, by catering to that line, possibly somewhat reducing his rates, he may apparently increase his final net income.

Studies by experts have so far shown that throughout the country the average overhead expense is at least 125 per cent of the direct pay-roll cost of laborers and checkers actually engaged in performing any particular handling operations.

The old method was *in* cost, plus estimated *out* cost, plus profit, or arbitrarily arrived at by making the rate the same as the storage rate. The correct method is *in* and *out* cost plus overhead, plus profit. Ten to twenty-five per cent is a very conservative amount to add to the combined direct labor and overhead cost of handling, for profit.

Wages have advanced to several times those paid since the old method of charging equal rates for storage and handling was first used. Taking into consideration these factors of increased wages, overhead expense and profit, it will be found that equitable handling rates may often be three or four times the rates shown in tariffs even now in use in some sections of the country, while, *per contra*, handling rates for some commodities may be less than the rate for storage.

The absorption in the handling charge (usually billed with the first month's storage) of the cost of unloading and loading cars, transfers from wharves to warehouses, cartage, weighing, and other services has been a growing evil. It has in effect given indirect rebates to certain customers and substantially added to the losses of the warehouseman, or reduced his profits. It has been proved that in some instances the cost of handling and other services absorbed have made it impossible to earn one cent from certain lots of merchandise until they have been in store four months or more, actual losses being incurred on lots removed from store within shorter periods.

The simplest handling operation is the receiving of goods from the tailboard of a truck, the hoisting and piling in warehouse and the redelivery to the tailboard of a truck (other services being sometimes required and sometimes not); it is therefore good accounting practice to make this the base operation charged for in the first month and make extra charges for extra services. Thus car loading and unloading should be charged for separately, as well as cartage, weighing, or any other service required, each being based on productive cost plus overhead, plus profit.

In these days of advancing wages, cost figures at the time goods are received may be based on a wage scale far lower than when the goods are delivered. The present method of billing for receiving and delivering allows no opportunity of taking care of this possible source of loss. The proper method of handling this phase of the subject would be to charge for the handling in when goods are received and to charge handling out to the party then owning the goods when delivery is made. This is such a radical charge that it is not deemed advisable to make such a recommendation at this time.

It is very essential that much data be secured in all parts of the country as to the productive labor cost of handling all kinds of merchandise. The American Warehousemen's Association has established a Central Bureau for the purpose of compiling data concerning handling costs; this information is being secured from all sections of the country and its value to a warehouseman cannot be overestimated.

Productive labor as used in this report is understood to mean the wage cost of the laborers and checkers while actually employed on an operation for which the warehouse is making a charge.

In order to make these records valuable in all sections of the country, they should be computed on a man-hour basis. By the use of man-hours real comparison may be made and results may be easily translated into dollars and cents by applying the wage per hour prevailing in any particular locality.

In addition to the establishment of the Central Bureau, information bureaus in connection with local associations of warehousemen with paid actuaries are being established throughout the country. Exchange of information in regard to man-hour costs between different parts of the country can thus be readily accomplished and all sections can quote reasonable rates even on commodities with which they are unfamiliar.

An example showing the method of applying this system of handling charges is given on the following page.

As the next package rate step above 14.4 is 15, this would be the handling rate to apply, assuming the example to be a fair average productive labor cost.

A method for securing productive labor costs as well as amount of overhead expense is shown in the later sections on Pay-Roll Division and Determination of Overhead.

RECEIVING AND DELIVERING 1,037 BAGS TAPIOCA

AVERAGE WEIGHT 152 LBS.

	Total Man-Hours	Man-Hours Per Package
Receiving		
1 checker, 9 men 5¼ hrs.....	52.50	.05
Delivering		
1 checker, 5 men 9½ hrs.....	57.00	.054
	109.50	.104

	Total Cost	Cost per Pkg. in Cents	Cost per 100 Lbs. in Cents
Labor cost, 109.50 man-hours at 55 cents	$60.23	5.8	3.81
125 per cent overhead.....	75.29	7.3	4.80
	$135.52	13.1	8.61
10 per cent profit.....	13.55	1.3	.86
	$149.07	14.4	9.47

UNIFORM COST ACCOUNTING

Uniform systems of accounts and statistical records form the bedrock upon which any rate foundation or structure must be built if the building is to stand the tests which are bound to be applied either by customers or by public officials. This is as pertinent to warehousing as it is to transportation or any other form of public utility.

In calculating rates, statistical data must be available from many warehouses in order that averages may be obtained upon which to establish standards. Uniform systems of keeping the accounts and statistics by the warehouses will be necessary in order to justify rates made for storage, handling, car unloading and loading, or any other service rendered.

A suitable system of uniform accounting will necessitate:

I. Classification of earnings or receipts.

Uniform classification with separate accounts for these earnings from all important sources:

(*a*) Storage.
(*b*) Handling.[3]
(*c*) Weighing and sampling.
(*d*) Miscellaneous extra services.
(*e*) Loading and unloading cars.
(*f*) All other miscellaneous sources of revenue.

II. Classification of expenses.
Uniform classification of expense of operating, with separate accounts subdivided as in earnings.
(*a*) Storage.
(*b*) Handling (corresponding to *b*, *c*, and *d*, under Earnings).
(*e*) Car service.
(*f*) Expenses connected with miscellaneous sources of revenue.

III. Determination of investment.
(*a*) Plant (land, buildings, private street).
(*b*) Equipment (elevators, trucks, etc.).
(*c*) Trackage facilities (land, car tracks, car platforms).

IV. Determination and application of overhead expenses.
All pay-roll items and other expenses which cannot be applied directly to Storage, Handling, Car Service, or any other particular service, must be analyzed and distributed according to a uniform plan. These being added to the direct costs, the entire or true cost of each service will be found.

CLASSIFICATION OF EXPENSES IN DETAIL

Expense (A) Storage.
Rent, or in lieu of rent.
1. Seven per cent on investment including buildings, land occupied by buildings and interest, taxes and insurance during construction.
2. Depreciation—2 per cent on value of brick or concrete buildings and 3 per cent on frame buildings.
3. Obsolescence.
4. Fire insurance on buildings.
5. Taxes, Federal, State and Municipal, applicable to real estate.

[3] Handling is here understood to mean the in and out handling from sill to sill of the warehouse, customarily charged in the first month.

6. Repairs to building.
7. Landlord's risk, amortization and profit on investment.

Administration and operating expenses, taxes, etc.

1. One-third of executives' salaries, salaries of departmental heads, office salaries, general office and miscellaneous expense.
2. Watching.
3. Advertising.
4. Interest on working capital.
5. Taxes. Applicable to storage.
6. Contingencies.

Explanatory Notes—Expense (A)

Investment.—If the plant is rented, estimated values should be used.

Depreciation.—Depreciation as usually allowed by the Internal Revenue Department is 2 per cent on brick or concrete buildings and 3 per cent on frame buildings.

Obsolescence.—Obsolescence as allowed by the Internal Revenue Department should be given due consideration.

Repairs.—This item comprises only ordinary repairs to keep buildings in good condition. Extraordinary repairs increasing the value of the plant should go to capital or investment accounts.

General Expenses.—An analysis of a number of warehouses shows that about two-thirds of the time of the office employees, and therefore the management also, is concerned with the various handling operations. Storage is rental and can be carried on by a very small force if a contractor or some other party attends to the handling. Office expenses, such as telephones, office coal and light, and sundry expenses, are also included in this item.

Watching.—Watching is for the protection of the property and reduces the fire insurance rate. It, therefore, is a proper storage expense.

Advertising.—Advertising for storage only belongs here. The warehouseman's principal business is that of storage, and handling is incidental to it; accordingly, it is proper to consider advertising for storage purely a storage expense. Advertising for laborers is a labor expense.

Interest on Working Capital.—A certain amount of working capital is necessary to carry bills receivable.

Expense (B) Handling; (C) Weighing and Sampling; (D) Miscellaneous Extra Service.

1. Actual warehouse labor employed productively, including warehouse clerks, checkers and weighers.
2. Nonproductive labor, including:
   Moving merchandise.
   Holiday time.
   Janitor and cleaning.
   Undistributed labor.
3. Liability insurance.
4. Seven per cent on the investment in equipment, including elevators, whips, trucks, scales, etc.
5. Taxes applicable to handling whether assessed on value of equipment, amount of working capital or on income.
6. Ten per cent depreciation on Item 4.
7. Repairs to equipment.
8. Power and light.
9. Claims.
10. Two-thirds of executives' salaries, salaries of departmental heads, office salaries, general office and miscellaneous expense. (Less amount charged to car service.)
11. Interest on working capital.
12. Miscellaneous supplies and expenses connected with labor.

NOTE A.—Items 2 to 12, inclusive, divided by Item 1 will produce the percentage of overhead expense for handling.

NOTE B.—Item 10 includes: Executive salaries, salaries of departmental heads, office salaries, office supplies, telephone, water, coal for office heating, contributions, and all miscellaneous small items of expense not directly chargeable to storage, handling, car service, or other miscellaneous services.

Explanatory Notes—Expenses B, C, D

Productive and Nonproductive Labor.—The method of finding these amounts by divisions of the pay roll is discussed in the section devoted to this subject.

Equipment Investment.—The investment in equipment should be determined by the warehouseman to furnish a basis for these figures.

Power and Light.—Furnishing of power or light is a labor service, varying according to the amount of merchandise handled,

storage as such not requiring either. They are therefore handling expenses. (Storage should be kept a simple space rental proposition.)

Claims.—This refers to breakage and loss claims due to negligence in handling merchandise. There are some claims which might be considered as storage liability, such as damage from leaking roofs. Each claim should be analyzed and placed where it belongs.

Portion of General Expenses.—Where the labor covers more than one service, it is defensible to distribute the overhead expense proportionately according to the percentage the gross billing for each service bears to the total gross billing for labor.

Miscellaneous Expense.—This covers items of general expense, directly chargeable to labor.

Lubricants for equipment, general care of equipment and employment departments are some items which are included.

Expense (E) Car Service.

1. Actual labor loading and unloading cars.
2. Nonproductive labor.
3. Liability insurance.
4. Seven per cent on investment in land, tracks and platforms.
5. Taxes applicable to Car Service.
6. Five per cent depreciation on investment in tracks, etc.
7. Repairs to tracks, etc.
8. A share of executives' salaries, salaries of departmental heads, office salaries and general office and miscellaneous expenses.
9. Interest on working capital.
10. Contingencies.

NOTE.—Item 8 should be determined as follows: Find the percentage relation which the billings for loading and unloading cars bear to the total billings, exclusive of storage. Credit the amount represented by this percentage to Item 10, Expense (B) Handling, (C) Weighing and Sampling, (D) Miscellaneous Extra Services, and charge a like amount to Item 8 under Expense (E) Car Service.

SYSTEM ILLUSTRATED BY A STANDARD WAREHOUSE CONSTRUCTED IN 1920

Showing Initial Cost of Plant with Estimated Capital, Fixed Charges, Operating Expenses, Operating Revenues and Net Return

This example has been prepared after exhaustive study of numerous estimates furnished by competent authorities, as a con-

servative illustration of the rates required to produce a reasonably adequate return. The majority of warehouse buildings constructed during 1920 have exceeded the estimated costs indicated below.

It should be carefully noted that this illustration covers a conservative estimate of the average cost of this type of warehouse and that the conclusions as to rates reached through its use must be revised upward or downward as the case may be, through consideration of local conditions, depreciation, land values, accessibility, etc.

SPECIFICATIONS

Standard reinforced 200′ × 100′ (outside dimensions), six stories and basement, flat slab construction with brick or hollow tile panels. Three 12″ fire walls of brick or hollow tile equally dividing building into four sections, and two concrete enclosed stairways. Clearance between floors 10′ except 15′ on first floor. All floors having not less than 250 lbs. per square foot rated floor-load capacity served with standard dry pipe Sprinkler system, two source supply, with tank of 50,000 gals. capacity. Equipment consisting of four (4) 8,000 pound elevators, four (4) double whip-hoists, electric lights, intercommunicating telephones between office and each floor, operating office, shipping clerks' office and room for laborers, necessary plumbing, heating and furniture for offices and laborers' room.

(No figures have been included for interior tiering machines and wiring, but these should be installed in any warehouse handling heavy materials.)

Facilities for handling cars consisting of two (2) railroad tracks with capacity for five (5) cars each, platform 10′ wide on track side of building.

Area outside walls	200′ × 100′ × 7 = 140,000	square feet
Area inside walls	195′ × 98′ × 7 = 133,770	" "
Area available (taking out office, shipping and laborers' rooms, elevators and stairways)	= 123,000	" "

ESTIMATED COST—1920

Land

For buildings.....	20,000	square feet	
For railroad siding and platform	7,000	" "	
For siding connection....	1,000	" "	
	28,000	square feet at $2	= $56,000

(No allowance is made for private streets which in many cases are necessary.)	
Building	
Construction, engineering and supervision including equipment and tank 140,000 square feet at $3.75....	$525,000
Two (2) tracks and platform 200′ × 10′.....	8,000
Equipment	
Elevators, whips, wiring, heating, plumbing, telephones, partitions and furniture for offices, shipping room and laborers' room	50,000
Organization and charter.....	2,000
Interest on land during construction—1 year at 7 per cent	3,920
Taxes and insurance during construction.....	11,620
Interest on building cost during construction.....	10,000
Working capital	83,460
Capital Assets	$750,000

(A) STORAGE

Estimated Income

One hundred twenty-three thousand square feet of available floor space at 96 cents per square foot per year based on 16 cents per square foot per month, 50 per cent of space occupied.....$118,080

NOTE.—Main aisles and columns occupy 25 per cent of total space inside of walls after deducting elevators, stairways, office, shipping and laborers' room. The above basis of 50 per cent therefore presupposes an average storage occupancy throughout the year of 66 2/3 per cent of actual occupiable storage space.

Estimated Expenses

Rent (or in lieu of rent)		
1. Interest on investment:		
Building	$525,000	
Land, portion occupied by building only..	40,000	
Organization	2,000	

	Interest, taxes and insurance during construction	25,540	
		$592,540 at 7 per cent	$41,478
2.	Depreciation, building above foundation ...	500,000 at 2 per cent	10,000
3.	Obsolescence	525,000 at 1 per cent	5,250
4.	Fire insurance 90 per cent of value of building above foundation.	450,000 at 1/8 of 1 per cent	562
5.	Taxes, Federal, State and Municipal		16,000
6.	Repairs to buildings....	500,000 at 1 per cent	5,000
7.	Landlord's risk, amortization and profit on investment	592,540 at 2½ per cent	14,814
	Total Rent (or in lieu of rent).....		$93,104

ESTIMATED ADMINISTRATION AND OPERATING EXPENSES, TAXES, ETC.

1.	One-third of executives' salaries, salaries of departmental heads, office salaries, general office and miscellaneous expense	$10,000
2.	Watchmen and watching supervision.....	2,500
3.	Advertising	3,000
4.	Interest on working capital—$50,000 at 7 per cent.	3,500
5.	Taxes	800
6.	Contingencies	2,676
	Total administration and operating expenses, taxes, etc.	$22,476
	Total storage expenses.....	115,580
	Net income from storage.....	2,500

Analysis

		Average Square Feet Floor Space Occupied	Dollars per Sq. Ft. per Year	Cents per Sq. Ft. per Month
Storage income	$118,080 divided by	61,500	1.92	16.00
Storage expenses	115,580 " "	61,500	1.88	15.67
Profit	2,500 " "	61,500	.04	.33
Investment				
Working capital				$50,000

2,500 divided by 50,000 = 5 per cent profit on investment.

Attention is directed to the fact that the profit here indicated covers Storage only, profit arising from ownership of the building being provided for under Rent. The proprietor's salary is included in executives' salaries.

Expense Items not Included in Estimate

Bailee's responsibility and risk.
Loss and damage on goods.
Bad debts.
Maintenance of private highways.

Income Items not Included in Estimate

Short periods of storage.

(B) HANDLING, (C) WEIGHING AND SAMPLING, (D) MISCELLANEOUS EXTRA SERVICE

Estimated Income

Receiving and delivering billed	$80,000
Weighing and sampling billed	7,000
Extra service billed	9,000
Total Income	$96,000

Estimated Expenses

1.	Actual productive labor employed in receiving and delivering, weighing and sampling, and extra service		$38,000
2.	Nonproductive labor		13,000
3.	Liability insurance		1,500
4.	Interest on investment in equipment—$50,000 at 7 per cent		3,500
5.	Taxes		1,600
6.	Ten per cent depreciation on Item 4		5,000
7.	Repairs on Item 4 at 5 per cent		2,500
8.	Power and light		3,000
9.	Claims		500
10.	Two-thirds of salaries, etc.	$20,000	
	Less amount charged to Car Service	5,455	14,545
11.	Interest on working capital—$26,000 at 7 per cent		1,820
12.	Miscellaneous expense		4,000
	Total Expense		$88,965
	Profit		7,035

Investment

Equipment	$50,000
Working capital	26,000
	$76,000

7,035 divided by 76,000 = 9.26 per cent profit on investment.

Total expense	$88,965
Productive labor	38,000
Handling overhead expense	$50,965

Per cent overhead expense 50,965 divided by 38,000 = 134 per cent.

(E) CAR SERVICE

Estimated Income

Unloading cars	$21,000
Loading cars	15,000
	$36,000

Estimated Expenses

1.	Actual labor loading and unloading cars		$14,000
2.	Nonproductive labor		6,800
3.	Liability insurance		700
4.	Interest on investment at 7 per cent:		
	Land	$16,000	
	Tracks and platform	8,000	
		$24,000	1,680
5.	Taxes		750
6.	Depreciation on tracks, etc.		400
7.	Repairs on tracks, etc.		750
8.	Share of executives' salaries, office salaries, etc.		5,455
9.	Interest on working capital—$7,460 at 7 per cent		522
10.	Contingencies		1,678
			$32,735
	Profit		3,265
Investment			
	Tracks, etc.		$24,000
	Working capital		7,460
			$31,460

3,265 divided by 31,460 = 10.38 per cent profit on investment.

Total car service expense		$32,735
Productive labor		14,000
Car service overhead expense		$18,735

Per cent overhead expenses 18,735 divided by 14,000 = 134 per cent.

PAY-ROLL DIVISION

In order that the warehouseman may determine his costs according to the method proposed, it becomes necessary to distribute the pay roll. The foundation of this is the use of daily time cards, either in the hands of the individual laborers or gang foremen, giving the time of the man or men, information as to the lot of goods handled and the different services performed. To be of real value this must be carefully carried on with competent supervision and made to

balance with the pay roll. A portion of the results will be productive labor costs and the balance nonproductive items, such as idle time, cleaning, moving merchandise to make room, etc.

DETERMINATION OF OVERHEAD

Next must be ascertained the overhead expense which applies to handling and other services. This is done by adding to the nonproductive labor, the liability insurance, interest, depreciation, taxes, repairs to equipment and other items as shown in the classification of Expense B, C, D and E.

COST DEPARTMENT

We recommend that each warehouseman, if he has not already done so, organize a Cost Department, headed by a man who combines good accounting ability with a practical warehouse experience, furnishing him with as much assistance as is necessary to keep the work up to date at all times.

The American Warehousemen's Association has established a Central Bureau, referred to elsewhere in this work, which is prepared to furnish warehousemen specimen forms and information concerning methods of keeping cost figures. The Primer furnished by the American Warehousemen's Association outlines a simple method of cost finding.

AN EQUITABLE PROFIT IN EACH DEPARTMENT

Each department of the warehouseman's plant should show a profit at the end of the year. No service should be rendered without profit. All profits should be reasonable.

Thus the Standard Warehouse Example shows profit after making due allowance for profit on the building, interest on the investment, and after salary to the proprietor, as follows:

Storage	$2,500
Handling:	
Weighing, sampling and miscellaneous services	7,035
Car Service	3,265
Total	$12,800

No department should perform a service free or below cost to

attract storage business, for indirect rebate is thereby given which will injure the business far more than the few dollars received for the storage gained.

This ideal condition, it is safe to say, has not heretofore existed in the warehouse industry.

CONCLUSION

The foregoing system of cost accounting and basis for tariffs, if carried out intelligently, will give the warehouseman the following knowledge:

Income, cost and profit of maintaining and operating each unit of warehouse space.

Income, cost and profit of handling each lot of merchandise from sill to sill.

Income, cost and profit of loading and unloading cars.

Income, cost and profit of weighing, sampling and all other services for which separate charges are made to the customer.

These fundamental facts will be of untold assistance in quoting and defending prices and setting a new and higher standard for the entire industry. A warehouseman will then have no hesitation in quoting rates to his customers because he will have that secure feeling that his rates are based upon proved costs with a legitimate profit added. These will also permit the warehouseman to exercise intelligent discrimination in the taking of merchandise to be stored by him.

Then, and only then, will the warehouse industry be enabled to ride out the squalls and serious storms which are bound to occur from time to time in the business world.

Respectfully submitted,

T. E. WITTERS, *Chairman.*

In closing the authors wish to express the hope that this imperfect pioneer effort will stimulate others to study the best methods of water-front operation and to give the benefit of their experience to the public in printed form.

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